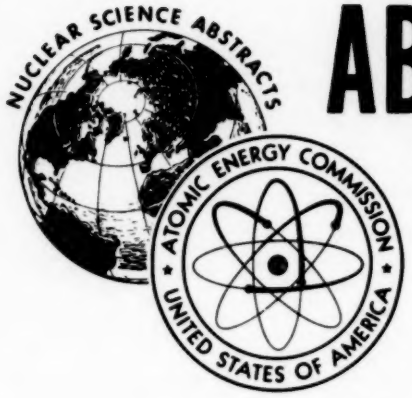
NUCLEAR SCIENCE ABSTRACTS



Volume 30 Number 7

Abstracts 18165-20578

October 15, 1974

UNITED STATES ATOMIC ENERGY COMMISSION

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Volume 30, Number 7, October 15, 1974

NUCLEAR SCIENCE ABSTRACTS

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Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

SMITH, H., Planetary nebulae: two types, 29:13374
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SMITH, J., See HOEGERMAN, S.F., 29:13035
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USAEC DIVISION OF CONTROLLED THERMONUCLEAR RESEARCH, WASHINGTON, D.C.
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Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from University Microfilms, Inc., 315 N. First Street, Ann Arbor, Michigan 48103.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

TABLE OF CONTENTS

Volume 30, Number 7, October 15, 1974

Category	Page
CHEMISTRY	1819
Analytical and Separations Chemistry	1819
Activation and Nuclear Reaction Procedures	1819
Chemical and Spectral Procedures	1821
Radiometric and Radiochemical Procedures	1823
Separation Procedures	1824
Inorganic, Organic, and Physical Chemistry	1826
Chemical and Physicochemical Properties	1826
Isotope Effects	1827
Isotope Exchange and Isotope Separation	1829
Feed Materials Processing	1830
Radiation Chemistry	1830
Radiochemistry and Nuclear Chemistry	1837
Hot-Atom Chemistry	1838
Properties of Radioactive Materials	1839
Radioactive Waste Treatment	1841
Radioisotope Production	1842
Reactor Fuel Reprocessing	1843
CONTROLLED THERMONUCLEAR RESEARCH	1844
Confinement and Heating	1844
Diagnostics	1845
Kinetics (General)	1846
Kinetics (Experimental)	1846
Kinetics (Theoretical)	1846
Production	1848
Stability	1848
Thermonuclear Engineering and Equipment	1848
Wave Phenomena	1849
ENGINEERING	1851
Energy Conversion	1851
Facilities and Equipment	1852
Heat Transfer and Fluid Flow	1857
Materials Testing	1859
Nuclear Explosions	1859
Protective Structures and Equipment	1863
Vacuum Engineering	1863
ENVIRONMENTAL AND EARTH SCIENCES	1864
Minerals and Ores	1864
Radioactive Effluents	1866
Radioactivity Monitoring and Transport	1866
Atmosphere	1868
Soil	1869
Water	1869
Ecosystems and Food Cycles	1870
Radiometric Techniques	1871
Site Surveys	1872
Thermal Effluents	1873
Chemical Effluents	1874
INSTRUMENTATION	1875
Radiation Detection Instruments	1875
General Detectors and Monitors	1875
Radiation Dosimeters	1877
INSTRUMENTATION (Cont'd.)	
Nuclear Spectroscopic Instrumentation	1880
High Energy Physics Instrumentation	1881
Radiometric Instruments	1882
Radiation Effects on Instrument Components, Instruments, or Electronic Systems	1883
Miscellaneous Instruments	1884
ISOTOPE AND RADIATION SOURCE TECHNOLOGY	1887
Isotope Separation (Industrial)	1887
Isotopic Power Sources	1888
Radiation Sources	1888
Design and Fabrication	1888
Industrial Uses	1888
LIFE SCIENCES	1891
Radiation Effects on Biochemicals	1891
Radiation Effects on Cells	1892
Radiation Effects on Microorganisms	1894
Radiation Effects on Plants	1896
Radiation Effects on Animals	1897
Man	1897
Vertebrates	1903
Invertebrates	1909
Radionuclide Effects (Internal Source)	1910
Man	1910
Animals	1910
Microorganisms	1910
Nuclide Kinetics and Toxicology	1910
Man	1910
Animals	1911
Plants	1912
Microorganisms	1913
New Tracer Techniques	1913
MATERIALS	1921
Ceramics and Cermets	1921
Metals and Alloys	1927
Corrosion and Erosion	1927
Preparation and Fabrication	1931
Properties, Structure, and Phase Studies	1934
Radiation Effects	1948
Other Materials	1950
NUCLEAR MATERIALS AND WASTE MANAGEMENT	1953
Accountability and Safeguards	1953
Disposal and Storage	1954
Handling Equipment and Procedures	1954
Transportation	1955
PARTICLE ACCELERATORS	1957
Design, Development, and Operation	1957
Auxiliaries and Components	1958
Ion Sources and Injection and Extraction Systems	1958
Ion Optics and Field Calculations	1958
Storage Rings	1959
Experimental Facilities	1960

TABLE OF CONTENTS (continued)

Category	Page
PHYSICS (ASTROPHYSICS AND COSMOLOGY)	1961
Cosmic Radiation	1961
Stars	1973
Quasi-Stellar, Radio, and X-Ray Sources	1975
Solar Phenomena	1977
Galaxies	1984
Cosmology	1985
Planetary Phenomena	1986
PHYSICS (ATMOSPHERIC)	1987
Auroral and Ionospheric Phenomena	1987
Magnetospheric Phenomena	1987
PHYSICS (ATOMIC AND MOLECULAR)	1989
Beams and Their Reactions	1989
Atomic and Molecular Properties	1989
Positronium, Muonium, and Muonic and Mesic Atoms and Molecules	1990
Collision Phenomena	1990
Atomic Theory	1993
PHYSICS (ELECTROFLUID AND MAGNETOFLUID)	1994
PHYSICS (HIGH-ENERGY)	1995
Particle Interactions and Properties (Experimental)	1995
Electromagnetic	1995
Weak	1995
Strong (Baryon-induced)	1995
Strong (Meson-induced)	1996
Particle Interactions and Properties (Theoretical)	1998
General	1998
Electromagnetic	1999
Weak	2000
Strong (General)	2002
Strong (Baryon No. = 0)	2003
Strong (Baryon No. = 1)	2004
Strong (Baryon No. ≥ 2)	2004
Particle Invariance Principles and Symmetries	2005
General	2005
Applications (Electromagnetic and Weak)	2006
Applications (Strong)	2006
Scattering Theory	2006
PHYSICS (LOW-TEMPERATURE)	2009
Superfluidity	2009
Superconductivity	2009
Equipment and Devices	2010
PHYSICS (NUCLEAR)	2012
Neutron Interactions with Matter	2012
Nuclear Properties and Reactions, $A < 5$	2014
Nuclear Properties and Reactions, $6 < A < 19$	2015
Nuclear Properties and Reactions, $20 < A < 38$	2019
Nuclear Properties and Reactions, $39 < A < 58$	2021
PHYSICS (NUCLEAR) (Cont'd.)	
Nuclear Properties and Reactions, $59 < A < 89$	2023
Nuclear Properties and Reactions, $90 < A < 149$	2024
Nuclear Properties and Reactions, $150 < A < 189$	2028
Nuclear Properties and Reactions, $190 < A < 219$	2030
Nuclear Properties and Reactions, $A > 220$	2031
Nuclear Theory	2035
PHYSICS (RADIATION AND SHIELDING)	2040
Radiation Physics	2040
Radiation Protection Standards	2040
Radiation Source Calibration and Standardization	2040
Shielding Calculations and Experiments	2040
PHYSICS (THEORETICAL)	2042
General	2042
Quantum Field Theories	2043
Gravitation and General Relativity	2046
REACTOR TECHNOLOGY AND REGULATION	2049
Power Reactors, Non-Breeding, BWR-Type	2049
Power Reactors, Non-Breeding, PWR-Type	2050
Power Reactors, Non-Breeding, Graphite Moderated	2051
Power Reactors, Non-Breeding, Otherwise Moderated	2052
Power Reactors, Breeding	2052
Research, Test, and Experimental Reactors	2054
Production and Materials Testing and Processing Reactors	2057
Propulsion and Package Reactors	2057
Reactor Safety and Environmental Aspects	2057
Reactor Theory and Calculation	2061
Reactor Components and Accessories	2062
Reactor Fuels	2063
Reactor Control Systems	2064
Nuclear Power Plant Economics	2065
Reactor Fuel Cycle Economics	2066
Reactor Licensing and Regulation	2066
GENERAL	2067
Energy Utilization and Economics	2067
Information Handling	2067
Law	2067
Mathematics and Computers	2067
Miscellaneous	2068
Chemistry	2068
Life Sciences	2068
Materials	2069
Physics and Engineering	2069
CORPORATE INDEX	INDEX-1
PERSONAL AUTHOR INDEX	INDEX-12
SUBJECT INDEX	INDEX-57
REPORT NUMBER INDEX	INDEX-170

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Volume 30, Number 7 October 15, 1974

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical and Separations Chemistry

Refer also to abstracts 19199 and 19417.

Activation and Nuclear Reaction Procedures

Refer also to abstracts 18803, 18828, 19019, and 19477.

18165 (SUNI-28, p 28) DETERMINATION OF BERYLLIUM IN BERYL BY THE COINCIDENT MEASUREMENT OF COMPLEMENTARY PARTICLES (CMCP). Coetzee, P. P.; Pretorius, R.; Peisach, M. (Southern Universities Nuclear Inst., Faure, South Africa). 1973.

18166 ACTIVATION ANALYSIS OF W + Co + Ti MIXTURES AND ALLOYS WITH THE USE OF 14 MeV NEUTRONS. Shinkarchuk, V. L.; Navalikhin, L. V.; Talanin, Yu. N.; Allaniyazov, M. Izotopy SSSR; No. 26, 23-24(1972). (In Russian).

A method was proposed for the determination of the basic components of W + Co + Ti mixtures and alloys by using fast 14-MeV neutrons. An analysis was made of the basic nuclear reactions which can be used for the determination of the quantitative concentration of Ti and Co in similar mixtures and alloys. (tr-auth)

18167 NEUTRON ACTIVATION ANALYSIS OF TRACE AMOUNTS OF MERCURY IN BIOLOGICAL TISSUE. Yeh, S. J.; Chen, P. Y. (National Tsing Hua Univ., Hsinchu, Taiwan). Nucl. Sci. J. (Taiwan); 8: No. 2, 17-25(Jun 1971). (In Chinese).

A rapid and simple method for the determination of mercury contents in several parts of the rice plant was studied by the neutron activation analysis. The procedure consists of radiochemical separation followed by measurement of ^{197}Hg radioactivity ($T_{1/2}$ = 65 hrs.) by multichannel pulse-height analyzer. The method was applied to the determination of mercury in rice plants treated with mercury pesticides. (auth)

18168 NEUTRON ACTIVATION ANALYSIS OF A HAND. Method of Monitoring Progressive Bone Disease. McIntosh, J. A. R. (Walsgrave Hospital, Coventry, Eng.); Catto, G. R. D. Bio-Med. Eng.; 9: No. 6, 245-246; 249(Jun 1974).

A sensitive method of detecting small changes in the calcium content of a hand by neutron activation analysis is described. A 25 Curie (α,n) source positioned within a perspex tube was used to expose the hand to the maximum thermal neutron flux and the 3.1 MeV gamma radiation from the activated ^{49}Ca was detected by two large NaI (Tl) crystals. The technique has been applied clinically to study the de-mineralizing process associated with chronic renal failure and has provided quantitative information on the rate of calcium loss from each patient. The efficacy of future therapy designed to limit this de-mineralizing process will be assessed in subsequent activation analyses. (auth)

18169 MAGMA DIFFERENTIATION AT NEWBERRY CRATER IN CENTRAL OREGON. Beyer, R. L. Eugene, OR; Univ. of Oregon (1973). 93p. University Microfilms Order No. 74-12,924.

Thesis (Ph. D.).

Sixty-eight samples from Newberry Crater and the surrounding area were analyzed by x-ray fluorescence and instrumental neutron activation analysis techniques. Abundances of major and minor elements, as oxides, and of eighteen trace elements are reported. Four groups of rocks were found in the Newberry suite and can be defined on the basis of silica and iron contents. Basalt-andesites range from 48 to 58% SiO_2 and from 7 to 10.5% FeO. High iron basalt-andesites range from 52 to 52.5% SiO_2 and from 11.5 to 13% FeO. The Amota Butte andesitic rocks range from 63 to 66% SiO_2 and from 5 to 6.5% FeO. Rhyolites range from 71 to 75% SiO_2 and from 1.5 to 3.5% FeO. Possible effects of processes of mixing, volatile transfer, fractional crystallization, and partial melting were explored. Variation (Harker) diagrams show straight-line trends for the basalt-andesite rocks and the Amota Butte rocks, indicating mixing as the primary means of differentiation of the basalt-andesites. (Diss. Abstr. Int., B)

18170 CHARGED PARTICLE ACTIVATION ANALYSIS APPLIED TO MEDIUM Z ELEMENTS. Kormali, S. M. College Station, TX; Texas A and M Univ. (1973). 107p. University Microfilms Order No. 74-13,077.

Thesis (Ph. D.).

A comprehensive survey has been made on the application of charged particle activation analysis for the detection of traces of medium Z elements ($40 \leq Z \leq 58$, 72, 74) using four different charged particles; protons and deuterons of 20 MeV, helium-3 and helium-4 ions of 40 MeV. The search for the product nuclides was limited to the radioisotopes with half-lives ranging from 10 minutes to 3 days. Under the experimental conditions used, proton activation was found to provide an optimum compromise between sensitivity and selectivity. The excitation functions for the following high sensitivity proton reactions were measured: $Zr(p,xn)^{90}Nb$, $Mo(p,xn)^{94}Tc$, $Mo(p,2n)^{93m}Tc$, $Pd(p,xn)^{104}Ag$, $Ag(p,n)^{107}Cd$, $Cd(p,xn)^{109}In$, $Cd(p,xn)^{110m}In$, $Cd(p,xn)^{113m}In$, $Sn(p,xn)^{115}Sb$, $Sn(p,xn)^{116m}Sb$, $Sn(p,xn)^{117}Sb$, $Sn(p,xn)^{118m}Sb$, $Te(p,2n)^{121}I$, $Te(p,xn)^{123}I$, $Te(p,n)^{128}I$, $Te(p,n)^{130}I$, $Cs(p,n)^{133m}Ba$. The feasibility of nondestructive determinations using 11-MeV protons for Zr, Mo, and Cd in high purity glass was investigated. Zirconium can be determined nondestructively and analytical results are presented and discussed. The estimated detection limit for the nondestructive zirconium determination is 0.001 ppm using a 12 μA-hour irradiation. The pertinent γ-ray energies were also redetermined. (Diss. Abstr. Int., B)

18171 CHEMICAL STUDY OF THE MINERALS FROM L-6 CHONDRITIC METEORITES. Curtis, D. B. Cornallis, OR; Oregon State Univ. (1974). 212p. University Microfilms Order No. 74-13,408.

Thesis (Ph. D.).

Major and minor minerals were separated from three L-6 chondritic meteorites (Alfianello, Colby (Wisconsin), and Leedey). Olivine, hypersthene, diopside, feldspar, troilite, chromite, phosphate minerals, and metallic minerals were analyzed for major, minor, and trace elements using instrumental neutron activation analysis and radiochemical neutron activation analysis techniques. Concentrations of the following elements were determined in some or all of the minerals which were separated: Al, Na, Ca, K, Rb, Cs, Cr, V, Mn, Mg, Zn, Sc, Fe, Ni, Co, Au, Se, S, Cl, La, Ce, Nd, Sm, Eu, Tb, Tm, Yb, Lu. The major element abundances were used primarily to evaluate contamination between minerals. An attempt was made to quantify the cross contamination and correct the trace element abundances accordingly. The distribution of elements within minerals, the partitioning of elements between minerals, and the chemical-mineralogical relationships suggest that many minor and trace elements have been distributed in an orderly fashion in L-6 chondritic meteorites. The rare earth elements (REE) have well defined differences in their absolute and relative abundances in the same minerals from the three meteorites. These chondrites were not in equilibrium with each other with respect to the REE. Rubidium and Cs are concentrated in the feldspar minerals. Rubidium is uniquely associated with the feld-

spars within the sensitivity of the techniques. Cesium is nearly ubiquitous among the meteoritic minerals. Quantities of Cs in minerals other than feldspar probably reflect the presence of Cs at grain boundaries and in interstitial sites. (Diss. Abstr. Int., B)

18172 APPLICATION OF NEUTRON ACTIVATION ANALYSIS IN HYDROLOGY. Schmitz, J.; Vogg, H. (Kernforschungszentrum, Karlsruhe). Geol. Jahrb., Reihe C; No. 2, 315-327(1972). (In German).

Neutron activation analysis is distinguished for the detection of numerous elements in the trace level. This may be used in hydrology to determine the origin of natural waters. Inactive labelling of water in connection with NAA (method of activable tracers) can reach the same excellent sensitivity. This is shown for example with 8 natural waters from the area of the Danube seepage. NAA with fast (14 MeV) and slow (nuclear reactor) neutrons can analyze in this case up to 20 trace elements in the microgram region and about macrocomponents. With the aid of high resolution semiconductor γ spectrometry, the analytical treatment of the waters is reduced to very simple procedures. The method of activable tracers is discussed in a practical example. (GE)

18173 TRACE ELEMENTS IN ATMOSPHERIC AEROSOL IN THE HEIDELBERG AREA, MEASURED BY INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS. Bogen, J. (Univ., Heidelberg). Atmos. Environ.; 7: No. 11, 1117-1125(Nov 1973).

The concentrations of 18 trace elements in atmospheric aerosol were measured by NAA and γ spectrometry using Ge(Li) detectors. Trace element concentrations of different filter materials used for aerosol deposition were determined. The trace element concentrations measured in Heidelberg are reported for the measuring period (Apr.–June 1971) and the average values are compared to values given for Paris, East Chicago, and Niles (U.S.). Considering the concentrations of the different elements in the aerosol relative to the concentration of Na, 3 groups of elements are of interest which are related to the ocean (Na and Cl), the earth crust (La, Fe, Sc, Mn, Cr, Ce, and Sm), and the anthropogenous production (Cd, Ag, Sn, Sb, Hg, Co, and Br) as the main sources. (Pollut. Abstr.)

18174 NEUTRON CAPTURE GAMMA RAY SPECTROMETRY FOR DETERMINATION OF SULFUR IN OIL. Pouraghabagher, A. R.; Profio, A. E (Univ. of California, Santa Barbara). Anal. Chem.; 46: No. 9, 1223-1226(Aug 1974).

Neutron capture gamma ray spectrometry was applied successfully for instrumental analysis of the sulfur content of fuel oil in the per cent range. Source-associated background and detection efficiency were studied to select a 7-cm source-detector spacing, using a 0.24-microgram ^{252}Cf source and 7.6-cm by 7.6-cm NaI(Tl) scintillation detector, with no gamma ray attenuator. This is probably the weakest neutron source that has been used for capture gamma ray analysis. The signal-to-background ratio was about 0.04 at 1% sulfur; hence, background had to be measured precisely in a run with a blank (pure fuel oil), and subtracted. Calibration against standard solutions gave 22.9 cpm per wt % sulfur. The lowest concentration measured with this source was 0.48%. The statistical precision of the net count rate was 41% at this concentration, decreasing to 8% error at 3.53 wt % sulfur, for a 33.33-minute run. A stronger source, e.g., 5 μg ^{252}Cf, will permit shorter data accumulation times or better sensitivity and precision. (auth)

18175 DETERMINATION OF COPPER IN COMPLEX MATRICES BY NEUTRON ACTIVATION ANALYSIS USING X-RAY DETECTION. Allen, R. O.; Brookhart, W. (Univ. of Virginia, Charlottesville). Anal. Chem.; 46: No. 9, 1297-1299(Aug 1974).

Following neutron activation of samples containing sodium, the measurement of the Ni–Kα x rays from the electron capture decay of ^{64}Cu provides greater sensitivity for copper determinations than conventional γ-ray analysis. Samples analyzed were solutions containing varying concentrations of sodium, biological materials, and USGS standard rocks. (JGB)

18176 RAPID, INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS FOR THE DETERMINATION OF URANIUM IN ENVIRONMENTAL MATRICES. Weaver, J. N. (North Carolina State Univ., Raleigh). Anal. Chem.; 46: No. 9, 1292-1294(Aug 1974).

A low energy photon (LEPD) detector is used to analyze ppB levels of uranium in NBS standard reference animal and plant tissues and ppM levels in coal, ores, and seawater. Comparison of data to true values is given. (auth)

18177 METHOD FOR DETERMINATION OF SELENIUM, ARSENIC, ZINC, CADMIUM, AND MERCURY IN ENVIRONMENTAL MATRICES BY NEUTRON ACTIVATION ANALYSIS. Orvini, E.; Gills, T. E.; LaFleur, P. D. (National Bureau of Standards, Washington, DC). Anal. Chem.; 46: No. 9, 1294-1297(Aug 1974).

This radiochemical separation method involves the combustion of the samples, followed by reduction with carbon monoxide and volatilization of the metals at high temperatures. Among the standard reference materials analyzed are tuna fish, coal, fly ash, and residual fuel oil. (JGB)

18178 DETERMINATION OF THE U DISTRIBUTION IN TEKTITES AND ASSOCIATED IMPACTITES USING THE FISSION TRACK METHOD. Storzer, D. (Museum National d'Histoire Naturelle, Paris); Selo, M. Compt. Rend., Ser. D; 278: No. 15, 1931-1934(8 Apr 1974). (In French).

The analysis of 200 impactites, microtektites, and tektites from North America, Europe, Africa, and Australasia demonstrated that the uranium contents of these minerals are more highly dispersed than previous results would lead to believe. For a given field distribution, the U contents of impactites are always higher than those of microtektites. This result was checked several times. (FR)

18179 ARSENIC CONCENTRATIONS OF HOUSEHOLD LAUNDRY PRODUCTS. Colasanti, V.; Hopke, P. K. (State University Coll., Fredonia, NY). Radiochem. Radioanal. Lett.; 18: No. 3, 123-128(1 Aug 1974).

There have been several reports of arsenic concentrations of 10 to 70 μg/g in various household laundry products. All of these earlier studies were made on products using phosphate-based water conditioners. Recently elimination of the phosphates from these products has been required by law. Since it was anticipated that the arsenic was present in these products as a trace impurity of the phosphates, the removal of phosphate might be expected to lower the arsenic content. Arsenic determinations using neutron activation analysis involving a post-irradiation separation have been performed on eleven household laundry products. These analyses indicate that the low phosphate products have significantly lowered arsenic concentrations. (auth)

18180 ACCURACY IN THE NONDESTRUCTIVE NEUTRON ACTIVATION ANALYSIS OF COAL AND BERYLLIUM FOR MINOR AND TRACE ELEMENTS USING COBALT AS A FLUX DETERMINANT. Tamura, N. (Japan Atomic Energy Research Inst., Tokai). Radiochem. Radioanal. Lett.; 18: No. 3, 135-142(1 Aug 1974).

Nondestructive activation analysis with γ spectrometry was applied to the determination of minor and trace elements in coal and beryllium. Cobalt was used to determine neutron flux and the literature values of cross section were used. The effect of epithermal neutrons was very small. Comparison of the results with those obtained by other methods shows that the proposed method has satisfactory accuracy that warrants routine analysis. (auth)

18181 GRADE CONTROL USING NEUTRON ACTIVATION ANALYSES AT THE SHERMAN MINE. Campbell, D. G. (Sherman Mine, Temagami, Ont.); Farm, P. D.; Gladysz, C. V. CIM (Can. Mining Met.) Bull.; 67: No. 746, 90-96(Jun 1974).

The development of a closed-loop automated system using an on-stream neutron activation analyzer and a control loop for measuring and closely controlling the SiO_2 in iron ore concentrate at the Sherman mine is described. Background into the use of Sherman iron ore pellets in Dominion Foundries' blast furnaces explains the need for close SiO_2 control. The over-all operation at the Sherman mine is described and the basic SiO_2 grade control concept is developed. Various SiO_2 control methods, such as wet analysis, atomic absorption and X-ray fluorescence, leading up to the development of the neutron activation system are detailed, showing a progressive improvement in pellet control. The complete control system is divided basically into two sections, measurement of % SiO_2 using the neutron activation analyzer and control of % SiO_2 using the analog control loop. Details of the theory, mechanics and assessment of the neutron activation equipment, and the various phases of development of the final analog control loop, are presented. (auth)

18182 DETERMINING NEODYMIUM IMPURITIES IN YTTRIUM–ALUMINUM GARNET CRYSTALS BY NEUTRON ACTIVATION. Abdukadyrova, I. Kh.; Bagdasarov, Kh. S.; Vakhidov, Sh. A.; Yusupov, A. A. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 1, 67-68(1974). (In Russian).

In order to control neodymium impurity in yttrium–aluminum garnet crystals, 20-mg samples were prepared along with standard samples. Surface impurities were removed by washing in acid and rinsing with water. The samples were then irradiated 10 hours to 1.6×10^{13} neutrons/cm^2 sec and cooled for 10 days to allow all short-lived activities to decay. The induced ^{147}Nd activity having 0.09 and 0.53-MeV gamma lines was counted on a scintillation spectrometer. The Nd content in the garnet was found to be $\sim 1 \times 10^{-3}$%. (SJR)

Chemical and Spectral Procedures

Refer also to abstracts 18366, 18392, 18592, and 19121.

18183 (BARC-698) X-RAY FLUORESCENCE DETERMINATION OF TRACE IMPURITIES Nb, Fe, Mn, AND Ti IN HIGH PURITY Ta_2O_5 AND K_2TaF_7. Agrawal, R. M.; Khanna, P. P. (Bhabha Atomic Research Centre, Bombay (India). Spectroscopy Div.). 1973. 21p. Dep. NTIS (US Sales Only) $4.25.

An x-ray fluorescence spectrometric method is described for the rapid determination of trace impurities Nb, Fe, Mn, and Ti in high purity Ta_2O_5 and K_2TaF_7. The sample is presented to the spectrometer in the form of a double layer pellet, where it is irradiated by x-rays from a high power x-ray spectrometry tube with tungsten target. The fluorescent x-rays emitted are analyzed using a LiF (200) crystal. Synthetic standards prepared from high purity compounds are used for the calibration purposes. Nb, Mn and Ti can be conveniently determined up to a lower limit of 20 ppM and Fe to 100 ppM. The standard deviation of the method is about ±10% for the concentration range around 50 ppM and ±2% for the range around 500 ppM. The limits of detection calculated for 100 seconds counting time are 10 ppM for Nb and Fe and 4 ppM for Mn and Ti. (auth)

18184 (BARC-699) X-RAY FLUORESCENCE ANALYSIS OF LOW ALLOY STEELS FOR Mo, Cu, Ni, Mn, Cr, AND V. Agrawal, R. M.; Khanna, P. P. (Bhabha Atomic Research Centre, Bombay (India). Spectroscopy Div.). 1973. 19p. Dep. NTIS (US Sales Only) $4.00.

An x-ray fluorescence method is described for the rapid determination of Mo, Cu, Ni, Mn, Cr, and V in low-alloy steels in the usual concentration range. Philips Semiautomatic x-ray Spectrometer PW 1220 and associated equipment has been used. The sample is presented to the spectrometer in the form of a disc of 40 mm or 1¼" diameter and ⅛" to 1" thickness. Low-alloy steel standards supplied and certified by Bureau of Analyzed Samples Ltd. are used. LiF (200) and/or Topaz crystals are used for x-ray dispersion. The standard deviation of the method is better than ±1%. (auth)

18185 (BARC-703) DIRECT SPECTROGRAPHIC DETERMINATION OF BORON IN UF_4. Murty, P. S.; Marathe, S. M.; Bai, P. R. (Bhabha Atomic Research Centre, Bombay (India). Electronics Div.). 1973. 10p. Dep. NTIS (US Sales Only) $4.00.

A spectrographic method for the determination of boron in uranium tetrafluoride using d.c. arc excitation is described. UF_4 is mixed with pure NaF in the ratio 20:1 by weight and thoroughly ground. Two hundred milligrams of this mixture is loaded in a carrier distillation type graphite electrode (U. C. C. 1998) and arced at 5 amp d.c. for 6 seconds. The spectra are recorded on a Hilger large quartz spectrograph in the wavelength region 2260–3000 Å. Antimony is used as the internal standard element. The B line at 2497.7 Å and the Sb line at 2445.5 Å are selected to serve as the analytical line pair. The sensitivity obtained for boron is 0.07 ppM. The precision of the method is about ±16%. (auth)

18186 (BNWL-tr-125) ELECTROCHEMICAL DETERMINATION OF OXYGEN AND THE THERMODYNAMICS OF ITS SOLUBILITY IN LIQUID METAL SYSTEMS. Sundermann, H. Translated by B. G. Russell from Mikrochim. Acta, Suppl. 5; 303-306 (1974). 5p. Dep. NTIS $4.00.

For direct determination of oxygen concentrations through EMF-measurements the thermodynamics of solubility was investigated for metallic melts and the influence of multinary components on dissolved non-metallic components accompanied by a change of activity was assessed. In addition to the transfer of activity, the thermodynamic relationships allow to transfer EMF-values to the analytically more interesting concentration values. With respect to each melt, the straight EMF-temperature lines dependent on oxygen content possess one common intersection at zero point of temperature, which is dependent only on the heat of solution. The theoretical relationships were confirmed experimentally in sodium and in copper melts with negligible error. (auth)

18187 SIMULTANEOUS SPECTROGRAPHIC DETERMINATION OF VOLATILE AND REFRACTORY IMPURITIES IN TANTALUM OXIDE USING A DC ARC EXCITATION. Chandola, L. C.; Dixit, V. S. (Bhabha Atomic Research Centre, Trombay, India). Curr. Sci. (India); 43: No. 12, 372-373(20 Jun 1974).

The use of proper weight ratio of ZnO and graphite as buffer make it possible to determine Al, Fe, Pb, Mn, Mo, Ni, Nb, Si, Sn, Ti, V, and Zr simultaneously in tantalum oxide by d.c. arc excitation. The ratio of 1:1:1 was found to give best overall sensitivity and uniform volatilization of impurities. A weak line of Ta at 2974.6 Å is used as an internal standard. The determination range in ppM and the precision of the determinations are tabulated. (JSR)

18188 X-RAY SPECTROSCOPY. Azaroff, L. V. (ed.). New York; McGraw-Hill Book Company (1973). 570p. $20.00.

Following an introductory review of x-ray spectroscopy, methods using two-crystal and grating spectrometry are discussed. The theory of emission spectra, many-body effects, x-ray absorption spectra, synchrotron radiation and applications, x-ray photoelectron spectroscopy, and bonding effects in x-ray spectra are considered. Appendixes present an x-ray wavelength table and x-ray energy levels. (MCG)

18189 DETERMINATION OF TRACES OF MERCURY, MOLYBDENUM, AND ARSENIC IN WATER. Kuan, L.; Li, N. (Univ., Peking). Hua Hseuh Tung Pao; No. 1, 15-19(23 Jan 1974).

Procedures are given for the determination of traces of mercury, molybdenum, and arsenic in water. For mercury, after a cold potassium permanganate digestion and washing with ammonium hydroxide (1:1), it is extracted with dithizone, and determined by monochromatic colorimetry. For molybdenum, sulfuric acid, amygdalic acid and sodium chlorate are added to the water, and the content determined by the chlorate polarographic catalytic wave. For arsenic, phosphorus is first extracted by ammonium molybdate and hydrochloric acid, then the arsenic is extracted with acetone, recovered with sodium hydroxide, and by adding sulfuric acid, amygdalic acid and sodium chlorate, the content is determined by the chlorate polarographic catalytic wave. (JPRS)

18190 GRAVIMETRIC DETERMINATION OF CERIUM(IV) AS ITS ARSENATE. Mamedov, I. A.; Nabiev, M. N. Uch. Zap., Azerb. Inst. Nefti Khim., Ser. 9; No. 7, 86-89(1972). (In Russian).

To 20 ml of hot test solution containing 4 to 70 mg of Ce, are added sufficient aqueous NH_3 (1:1) to produce slight turbidity and 2 to 2.5 ml of H_2SO_4 (2:5) or 3 to 4 ml of HNO_3 (1:1) in the presence of 0.5 to 1 g of $(NH_4)_2SO_4$. The mixture is boiled and treated with 20 to 25 ml of 20% Na_3AsO_4 solution of pH 4 (in small portions), and is maintained at the boiling point for ≈10 min. The precipitated $Ce_3(AsO_4)_4$ is filtered off, washed 4 or 5 times with hot water, dried at 100° to 105° for 30 to 40 minutes and weighed. The error is 0.3%. (Referativnyi Zh.)

18191 COMPOSITE ELEMENTAL STANDARDS FOR QUANTITATIVE ELECTRON MICROSCOPE MICROPROBE ANALYSIS. Rowse, J. B.; Jepson, W. B.; Bailey, A. T.; Climpson, N. A.; Soper, P. M. (ECLP and Co. Ltd., St. Austell, Eng.). J. Phys., E (London); 7: No. 7, 512-514(Jul 1974).

In quantitative electron microscope microprobe analysis using the "ratio method," standards containing known relative amounts of two or more of the sought elements are required. Techniques are described for the preparations of such standards. Suitable oxides, hydroxides or silicate minerals are first refined, where necessary, to less than 0.5 μm equivalent Stokes' diameter. The appropriate mixture is then prepared as a slurry in water, filtered, and dried. One part is embedded in a resin; sections about 1200 Å thick are cut with an ultramicrotome and examined using a probe diameter of about 60 μm. The other part is analyzed for the chosen elements by conventional wet chemical methods. The method has been verified for five series of standards containing Si plus one of Mg, Al, Ti, Fe and K. Plots of characteristic x-ray intensity ratio against atom ratio were linear with coefficients of variation in the slopes between 1.7 and 5.0%. An example shows the application of the method to the analysis of kaolinite particles. (auth)

18192 DETERMINATION OF LEAD, TIN, TELLURIUM, AND SOME DOPING ELEMENTS IN $Pb_xSn_{1-x}Te$. Fano, V.; Zanotti, L. (CNR, Parma, Italy). Microchem. J.; 18: No. 1, 1-7(1973).

Dissolve the sample (0.1 g) in HNO_3–HCl (1:3) (4 ml) and evaporate the excess of HNO_3; dilute to produce a solution containing 3% of concentrated HCl, and precipitate the Te at 80°C with SO_2. Filter off the precipitate, wash it with H_2O and ethanol, then dry it at 105°C and weigh. To the hot filtrate add saturated aqueous benzenearsonic acid (20 ml) and, after several hours filter off the precipitate, wash it with 4% aqueous NH_4NO_3, ignite at 1075 to 1100°C and weigh as SnO_2. Evaporate the HCl from the filtrate, then determine Pb by precipitation as $PbSO_4$, and evaporate the remaining filtrate to remove H_2SO_4. Dissolve the residue in H_2O (20 to 30 ml), adjust to pH 7 with aqueous NaOH and deposit the doping elements (Cu, Cd, and Zn) from M-NaCl on to a hanging-mercury-drop electrode at −1.3 V vs. the S.C.E. and determine them by anodic-stripping voltammetry. (Anal. Abstr.)

18193 APPLICATIONS INVOLVING THE IODIDE ION. VII. Determination of Small Amounts of Cerium(IV) and Analysis of Its Mixtures With Some Metal Ions. Khalifa, H.; Barsoum, B. N. (Cairo Univ., Giza, Egypt). Microchem. J.; 18: No. 4, 428-435 (1973).

To determine Ce^{IV} (15 to 1000 μmoles), the test solution (1 to

5 ml) is treated with KI solution in 3.5 to 5.5-fold excess, then with sufficient H_2SO_4 to give a concentration of 2N (for micro amounts of Ce^{IV}) to 0.2N (for macro amounts). Unconsumed I^- is then titrated potentiometrically with $Hg(NO_3)_2$ solution with use of a silver amalgam indicator-electrode. There is no interference from, e.g., alkaline-earth metals, lanthanoids, or Fe^{III}. For binary mixtures of Ce^{IV}, with, e.g., Th, La, Ce^{III}, Cd, or Fe^{III}, the Ce^{IV} is determined by the above method. To determine the sum of the metals, in a separate portion of the test solution Ce^{IV} is reduced by boiling with aqueous H_2O_2 and, after evaporating to small volume to remove the H_2O_2, EDTA, hexamine and aqueous NaOH are added and the unconsumed EDTA is titrated potentiometrically with $Hg(NO_3)_2$ solution. For ternary or quaternary mixtures, Ce^{IV} and the sum of the metals are determined as already described. Detailed procedures for application to mixtures of Ce^{IV} with Th and La; Sc and Cu^{II}; Ce^{III} and Ni; Fe^{III} and Cd; Ce^{III}, Th and La; or Sc, Cu^{II} and Cd are given. Results are presented to show the validity of the methods. (Anal. Abstr.)

18194 MINIATURE, NANOSECOND SPARK SOURCE FOR FLUORESCENCE LIFETIME DETERMINATIONS AND FOR TIME-RESOLVED EMISSION SPECTROCHEMICAL ANALYSIS. Zynger, J. East Lansing, MI; Michigan State Univ. (1973). 217p. University Microfilms Order No. 74-13,995.

Thesis (Ph. D.).

A high power, low duty cycle source is described for fluorescence lifetime measurements. The spark source was used as an excitation source for solution analysis by emission spectroscopy. Samples are introduced into the spark source as dry salt particles which are formed by solution nebulization into a heated desolvation chamber. The spark is formed through a stream of argon that transports the desolvated aerosol. The emitted radiation is detected with a photoelectric, time-resolved detection system which employs a gated, synchronous integrator that is controlled by a digital timing and sequencing system. The time-resolved spectral characteristics of the spark source are presented. The spark plasma is also characterized according to its electron density, the processes that govern the continuum emission, and its spectroscopic and ionization temperatures. The spark source is applied to the spectrochemical determination of Si, Mo, C, Ca, B, P, Cu, and Al. Working curves and detection limits are presented, for these eight elements, obtained using time-slicing and time-resolution. It is shown that time resolution enhances the sensitivity. The detection limits obtained are critically compared to the sensitivities obtained by other spectrochemical techniques. The detection limits obtained are all in the sub-ppM range. (Diss. Abstr. Int., B)

18195 ATOMIC ABSORPTION PROCEDURE FOR ANALYSIS OF METALS IN ATMOSPHERIC PARTICULATE MATTER. Ranweiler, L. E.; Moyers, J. L. (Univ. of Arizona, Tucson). Environ. Sci. Technol.; 8: No. 2, 152-156(Feb 1974).

A procedure is presented for the multielement analysis of atmospheric particulate matter by atomic absorption spectrometry. Atmospheric particulate samples are collected on polystyrene filters by hi-volume samplers. The filters are dry ashed at 400°C to 425°C and the residue is dissolved with a mixture of hydrochloric, hydrofluoric, and nitric acids in Teflon acid digestion bombs. With the appropriate dilutions and matrix corrections, it is possible to measure quantitatively 22 metals in atmospheric particulate matter. The elements measured by this procedure are Si, Al, Ca, Fe, K, Na, Mg, Pb, Cu, Ti, Zn, Sr, Ni, V, Mn, Cr, Rb, Li, Bi, Co, Cs, and Be. Although it is possible to observe Cd in samples collected and prepared by this technique, it is probable that Cd is partially volatilized during ashing of the sample. Recovery data for the ashing and dissolution of synthetic samples added to the filter material are presented. Data are also provided for the atmospheric concentration of elements in particulate samples analyzed by this procedure. (Pollut. Abstr.)

18196 FOTOMETRICHESKII ANALIZ. Metody Opredeleniya Nemetallov. (Photometric Analysis. Methods for the Determination of Non-Metals). Babko, A. K.; Pilipenko, A. T. Moscow; Izdatel'stvo Khimiya (1974). 360p.

Methods for the photometric determination of N, B, Si, P, As, O, S, Se, Te, F, Cl, Br, and I are reported. The absorption spectra of the compounds in which the determination is made are given. The sensitivity of the methods, ions interfering in the determination, and methods for their removal are indicated. Methods for the determination of non-metals in different materials are described. (tr-auth)

18197 SPECTROPHOTOMETRIC DETERMINATION OF HAFNIUM IN THE PRESENCE OF ZIRCONIUM. Konunova, Ts. B.; Popov, M. S.; Chernega, L. P. (Kishinev Polytechnical Inst.). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 17: No. 5, 758-761(1974). (In Russian).

A method was developed for the spectrophotometric determination of Hf in the presence of Zr. It is based on the formation by these metals of colored complexes with eriochromcyanin. The Zr is masked by hydrogen peroxide. (tr-auth)

18198 DETERMINATION OF MICROIMPURITIES OF THORIUM IN SALTS OF ZINC, CADMIUM, AND COBALT BY CONCENTRATION OF THE COPRECIPITATES. Chmilenko, F. A.; Dovgal, V. I.; Chuiko, V. T. (Dnepropetrovsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 17: No. 6, 938-940(1974). (In Russian).

A method for the concentration of microimpurities of Th from solutions of salts of Zn, Cd, and Co is described. It is based on their coprecipitation with the arsenates of these metals. On the basis of the use of this concentration a method was developed for the determination of thorium ($n \times 10^{-7}$%) in these salts. A process was also developed for their purification from Th (up to 1×10^{-6}%). (tr-auth)

18199 DIFFUSION CONTROLLED, THERMAL IONIZATION SOURCE FOR MASS SPECTROMETRIC ANALYSIS OF TRACE METALS. Rec, J. R.; Myers, W. G.; White, F. A. (Rensselaer Polytechnic Inst., Troy, NY). Anal. Chem.; 46: No. 9, 1243-1247 (Aug 1974).

Analysis sensitivities achievable with the thermal ionization, mass spectrometric technique for trace quantities of uranium and plutonium are improved by replacement of the commonly employed direct evaporation, single-filament source with a diffusion controlled source. The sample on the single filament surface is coated with a high work function, refractory metal using a R.F. sputtering technique. The arrival of sample atoms at the ionizing surface is controlled by diffusion through the applied coating. Nickel, tungsten, and rhenium coatings were evaluated. Only the rhenium coats were found to be thermally stable, adherent, and visibly defect free. Coated and uncoated uranium and plutonium samples were mass spectrometrically analyzed. The coated samples were at least four times more efficient in sample utilization than the uncoated samples. Analytical sensitivities of at least 1×10^{-15} grams plutonium on the filament were observed with comparable sensitivities estimated by extrapolation for uranium. (auth)

18200 DIRECT DETERMINATION OF TRACE QUANTITIES OF LEAD, BISMUTH, SELENIUM, TELLURIUM, AND THALLIUM IN HIGH TEMPERATURE ALLOYS BY NON-FLAME ATOMIC ABSORPTION SPECTROPHOTOMETRY. Welcher, G. G.; Kriege, O. H.; Marks, J. Y. (Pratt and Whitney Aircraft, East Hartford, CT). Anal. Chem.; 46: No. 9, 1227-1231(Aug 1974).

The determination of ppM concentrations of lead, bismuth, selenium, thallium, and tellurium in high temperature alloys is difficult because of the sensitivity required, the complex matrices, and the lack of standard materials. A new analytical method was developed which offers significant advantages over other procedures for the determination of these critical trace elements in high temperature alloys. The new method utilizes highly sensitive non-flame atomic absorption spectrophotometry with simultaneous background correction for the determination of trace elements without prior separation. This technique is reliable and the most rapid available for the analysis of high temperature alloys for all five trace elements. (auth)

18201 SIMULTANEOUS DETERMINATION OF HAFNIUM AND ZIRCONIUM IN SILICATE ROCKS BY ISOTOPE DILUTION. Owen, L. B.; Faure, G. (Ohio State Univ., Columbus). Anal. Chem.; 46: No. 9, 1323-1326(Aug 1974).

Concentrations of Hf and Zr in a suite of rock standards were measured by isotope dilution using spikes enriched in ^{179}Hf and ^{91}Zr, respectively. The isotopic composition of each element was measured from the same filament loading in a solid-source mass spectrometer. Results indicate that precision and accuracy is at least as good as those of other available methods. (auth)

18202 USE OF REAGENTS IN THE GLYOXAL BIS(2-HYDROXYANIL) CLASS IN THE SPECTROPHOTOMETRIC DETERMINATION OF INDIUM, SCANDIUM, THALLIUM, AND URANIUM. Leathers, D. J. Clemson, SC; Clemson University (1973). 96p. University Microfilms Order No. 74-16,122.

Thesis (Ph. D.).

Glyoxal bis(2-hydroxyanil), the 4-methyl derivative, the 5-methyl derivative, the 4,5-dimethyl derivative, the 5-chloro derivative and the 5-nitro derivative were studied as spectrophotometric reagents for indium, scandium, thallium, and uranium. Indium and scandium formed color in acidic solutions, while uranium and thallium required strongly basic, 80% methanol solutions for color development. Spectrophotometric methods for the determination of each metal ion were developed. Combining ratios and apparent formation constants for the indium, scandium, and uranium complexes were determined by use of the method of continuous variations. The log-ratio method was used to determine these data for the thallium complexes. The log-ratio method was used because the complexes of these re-

agents with thallium are relatively weak. The log-ratio method is also very useful in those cases where both the ligand and complex absorb at about the same wavelength. One-to-one complexes were found in all cases. Results indicated that the 4-methyl derivative was the most sensitive reagent, the 4,5-dimethyl derivative formed the most stable complexes and the 5-methyl derivative was most resistant to decomposition. The nitro and chloro derivatives were worthless in basic media and were not as sensitive as the parent compound in acidic media. (Diss. Abstr. Int., B)

18203 CARRIER DISTILLATION METHOD FOR ESTIMATION OF BORON IN CaF_2. Grampurohit, S. V.; Dixit, V. S. (Bhabha Atomic Research Centre, Trombay, India). Anal. Lett.; 7: No. 4, 293-298(Apr 1974).

A carrier distillation method is described for determination of boron in calcium fluoride. The sample is mixed with 5% copper oxyfluoride containing 200 ppM of gallium. Fifty mg of this mixture is loaded in pre-arced U.C.C. 1990 electrode and excited using 15 A dc arc. The resulting spectra are recorded in the region 2200 to 2850 Å employing Hilger larger quartz spectrograph. The detection limit for boron is 0.1 ppM and the precision of the method is ±12%. (auth)

18204 DETERMINATION OF PLUTONIUM IN THE PRESENCE OF FLUORIDE IONS. Spevackova, V.; Kuvik, V.; Krtil, J. (Inst. of Nuclear Research, Rez, Czech.). Radiochem. Radioanal. Lett.; 18: No. 3, 151-155(1 Aug 1974).

The influence of fluoride ions on the titrimetric determination of plutonium has been studied. For F:Pu mole ratio higher than three lower values for plutonium were obtained. The interference of fluoride ions was successfully eliminated by evaporating the sample solution twice with nitric acid, or by the complexing of fluoride ions with boric acid. (auth)

18205 PHOTOMETRIC DETERMINATION OF Nb IN STEELS WITH PAR. Slama, J. (National Inst. of Materials Research, Prague). Hutn. Listy; 28: No. 5, 365-366(May 1973). (In Czech).

Use of 4-(2-pyridylazo)-resorcinol (PAR) in the photometric determination of 0.2 to 3% of Nb in Zr steels is described. A detailed description is presented of the Nb determination procedure in a 1 g sample by means of a calibration curve. The amount of W up to 5%, Ti up to 5%, Ta up to 1.6%, and Zr up to 1% did not affect the determination. (Nuclear Sci. Abstr. Czech.)

Radiometric and Radiochemical Procedures

Refer also to abstracts 18597, 18630, 18659, 18667, 18707, and 18805.

18206 (SUNI-28, pp 23-24) ELEMENTAL ANALYSIS BY DIFFERENTIATED BACKSCATTERING SPECTROMETRY. Peisach, M. (Southern Universities Nuclear Inst., Faure, South Africa). 1973.

18207 TESTING OF THE POSSIBILITIES OF USING RADIOACTIVE KRYPTONATES FOR THE DETERMINATION OF CARBON MONOXIDE IN AIR. Naoum, M. M.; Pruzineo, J.; Toelgyessy, J. (Slovak Technical Univ., Bratislava). Jad. Energ.; 20: No. 3, 92-93(Mar 1974).

Three kryptonated carriers were supposed to be sensitive for the determination of carbon monoxide in the air in which ^{85}Kr would be released. In case of the kryptonate of either hopcalite or nickel the results were found to be not suitable since these are surface-catalized reactions and no destruction of the material itself occurs. Radioactive kryptonate of palladium chloride was proved to be the only sensitive reagent for this determination either by measuring the released activity or by comparing the residual activity left by the disk. (auth)

18208 COUNTING OF ^{85}Kr IN BLOOD BY LIQUID SCINTILLATION TECHNIQUE. Mensch-Dechenc, J.; Briancon, L.; Polianski, J.; Lockhart, A.; Durand, J. (Univ., Paris). Biomedicine; 21: No. 3, 146-150(20 Mar 1974). (In French).

Liquid scintillation was adapted to the determination of activity of ^{85}Kr dissolved in blood. One ml of blood of specific activity from $5 \cdot 10^{-7}$ to 10^{-3} mCi · ml^{-1} was introduced at the bottom of a 22 ml vial containing 12 ml of liquid scintillator in toluene. Counting rate rose during 70 minutes, plateaued for the next 60 min, and then decreased exponentially. A close linear (r-0.98) relation between activity and counting rate was observed 100, 240, and 360 min after preparation of the sample. The coefficient of variation equal to or less than 2 and 5% when the activity was greater than or equal to $5 \cdot 10$ and $5 \cdot 10^{-7}$ mCi respectively. Counting efficiency was approximately 40%. This provided for a good statistical accuracy of counting rates thus made it suitable for detecting in clinical practice small quantities of ^{85}Kr. The simplicity of the technique and minimum blood requirement may be useful for multiple determinations in man. (FR)

18209 MEASUREMENT OF ^{131}I IN RAW MILK USING A GAMMA PULSE-HEIGHT ANALYZER. Kamata, H. (National Inst. of Radiological Sciences, Chiba, Japan). Hoshasen Kagaku; 16: No. 6, 118-121(Jun 1973). (In Japanese).

Practical application of the measurement of ^{131}I in raw milk in due consideration of ^{40}K and ^{137}Cs as factors of spectrum was examined. Hitachi γ-ray energy pulse height analyzer was used for measurement. γ-ray spectrum in standard solution samples of ^{131}I, ^{137}Cs and ^{40}K was determined. Peak ratio and count efficiency of each radioactive nuclide were calculated from the net count rate in each fraction using photopeak 0.36 MeV in ^{131}I, 0.662 MeV in ^{137}Cs and 1.46 MeV in ^{40}K. Net count rate of photopeak fraction in synthesized spectrum was calculated from the rate of effect of 3 photopeaks on other fractions (interference coefficient) and the net count rate in each photopeak fractions. γ-ray spectra were measured in 21 samples of raw milk to which ^{131}I standard solution was added and that without radioactive iodine. Width of photopeak, count efficiency, peak ratio and interference coefficient in each photopeak fraction of ^{131}I, ^{137}Cs and ^{40}K were obtained. Results of analysis revealed a close correspondence between additive amount of ^{131}I and measurement value. Measurements were performed in 10 networks for the practical application of this method, and the deflection in data probably produced by the effect of channel drift and so on was great. (JA)

18210 NEW METHOD OF MEASURING CHROMATOGRAMS WITH SOFT BETA-EMITTERS. Vdovenko, V. M.; Bobrova, V. N.; Rys'ev, O. A.; Zharkov, A. V.; Surov, N. A.; Ivanova, I. F. Sov. Radiochem. (Engl. Transl.); 15: No. 4, 595-599(1973).

Translated from Radiokhimiya; 15: No. 4, 595-600(1973).

A dry scintillation method of measuring radiochromatograms with soft β emitters has a sensitivity 3 to 4 times as high as that of the ionization method of measuring radiochromatograms at the present time. The lower the energy of the β particles, the greater are the advantages of the scintillation method. The counting efficiency for tritium on paper chromatograms lies in the range of 6 to 8% and on thin-layer chromatograms it is 6 to 12%, depending on the properties of the scintillator used. The dry scintillation method makes it possible to use simple automatic devices for measuring the radiochromatograms. The scintillation chromatographic apparatus (USKh-1) is being produced commercially. (auth)

18211 QUICK RADIOCHEMICAL SEPARATION OF YTTRIUM FROM MIXED FISSION PRODUCTS. James, W. D.; Adams, D. E.; Sigg, R. A.; Beck, J. N.; Kuroda, P. K. (Univ. of Arkansas, Fayetteville). Radiochem. Radioanal. Lett.; 18: No. 1, 7-14(2 Jul 1974).

A radiochemical procedure is presented for the measurement of the 19-min activity of ^{94}Y from mixed fission products of uranium and thorium. The known existing decontamination schemes for the separation of radioyttrium require at least 3 hours. This time is sufficient for the total decay of ^{94}Y in the sample. The important decontamination steps include precipitation of the yttrium as a fluoride and as a hydroxide, and elution through a Dowex 1 × 8 anion exchange column with saturated hydrochloric acid. The final step is the elution of the yttrium and contaminating rare earth nuclides through a Dowex 50W-X8 cation exchange resin with 0.2 M 2-methyllactic acid. Chemical yields ranged from about 45 to 55% and a decontamination factor on the order of 10^7 was calculated. (auth)

18212 DETERMINATION OF RADIORUTHENIUM IN URINE. Holgye, Z. Prac. Lek.; 26: No. 4, 127-129(Apr 1974). (Slovak).

A selective method for determination of radioruthenium in urine was elaborated. A sample of urine is mineralized by nitric acid. Ruthenium is oxidized by potassium permanganate to RuO_4, which, after being distilled-off, is trapped in diluted hydrochloric acid. After dissolving the ruthenium evaporation residue in distilled water, the ruthenium is precipitated by sodium carbonate. The activity of the sample is radiometrically determined. The chemical yield is ascertained photometrically. In processing 100 ml of urine, the sensitivity of the method amounts to 15 pCi $^{106}Ru/1$ liter urine. (auth)

18213 RADIOMETRIC ASSAY OF PARTICULATE MATTER IN FLUIDS. Fries, B. A.; Parker, C. K. (to Chevron Research Co.). US Patent 3,824,395. 16 Jul 1974. Filed date 28 Jan 1972. 6p.

A porous filtering medium is rendered radioactive by incorporation of a radioactive isotope within it, or by coating it with an insoluble radioactive isotope, having weakly penetrating radiation. This source of radioactivity is first counted. The fluid to be assayed is then filtered through the filtering medium and the attenuation of radiation due to collected solid material is proportional to the amount of particulate matter in the filtered fluid. The method may be automated and assays made continuously. (Official Gazette)

18214 SEMICONDUCTOGRAPHIC DETERMINATION OF LABELLED SUBSTANCES IN THIN-LAYER CHROMATOGRAPHY. Tykva, R.; Votruba, I. (Inst. of Organic Chemistry and Bio-

chemistry, Prague). J. Chromatogr.; 93: No. 2, 399-404(26 Jun 1974).

A method is presented for the radioactive detection of β-nuclide-labelled substances in thin-layer chromatography. The method is based on a scanning device with a semiconductor detector; the detection proceeds in the laboratory atmosphere and at room temperature. The measurement and recording may be programmed on a computer. Conditions are considered for ^{3}H- and ^{14}C-detection and also for the detection of simultaneously present ^{14}C and ^{35}S, after the chromatographic separation of nucleic acid components. (auth)

18215 DETERMINATION OF THE COMPOSITION OF ALKALOID TETRAIODOBISMUTHITE, TETRAIODOCADMATE AND TETRAIODOMERCUPATE BY RADIOMETRIC TITRATION. Yoshimura, M.; Sugii, M.; Fujimura, Y.; Tomita, Y. (Nagasaki Univ., Japan). Jap. Anal.; 23: No. 3, 280-283(Mar 1974). (In Japanese).

Dragendorff's, Malme's and Meyer's reagents are known as sensitive precipitants for alkaloids. It is considered that the insoluble precipitates are formed by the reaction of complex anions, e.g., $[BiI_4]^-$, $[CdI_4]^{2-}$, and $[HgI_4]^{2-}$ with alkaloids. A more detailed study was needed concerning these insoluble precipitates, because various formulas had been proposed for the composition of the precipitates. For this purpose, radiometric titration of ^{131}I-labeled Dragendorff's reagent with various alkaloids was investigated. Four milliliters of 0.02M $Bi(NO_3)_3$ in acetic acid was added to each of 13 small flasks, to which 4 ml of 0.2M $K^{131}I$ was added. Increasing amounts of 0.02M alkaloid solution were added to the above each ^{131}I-labeled Dragendorff's reagent. After standing 3 hours, the precipitates were filtered off and each 1 ml of filtrate was counted by well type scintillation counter. The radioactivity was corrected for dilution by the alkaloid solution. The equivalent point of titration curves was clearly observed. From the titration curves, it was found that the alkaloids such as atropine and tetraethylammonium iodide, which contained one basic nitrogen atom, reacted with Dragendorff's reagent to form a 1:1 molar ratio precipitates. The alkaloids such as quinine (pK_1 6.0, pK_2 9.89), emetine (pK_1 5.77, pK_2 6.64), and nicotine (pK_1 6.16, pK_2 10.86), which contained two basic nitrogen atoms, reacted with the reagent to form a 1:2 molar ratio precipitates. However, it was found that the alkaloid such as brucine (pK_1 6.04, pK_2 11.7), which contained two basic nitrogen atoms but the basicity of one nitrogen atom was very weak, reacted with the reagent to form a 1:1 molar ratio precipitate. Similarly, this method was applied to various alkaloids with ^{131}I-labeled Malme's and Meyer's reagents, though the precipitates from them showed rather larger solubilities. The determination of the composition of the soluble precipitates was unsuccessful but the insoluble precipitates showed reasonable molar ratio. For example, quinine and emetine reacted with the reagents to form a 1:1 molar ratio precipitate, while brucine formed a 1:0.5 molar ratio precipitate. (auth)

18216 APPLICABILITY OF MOESSBAUER SPECTROMETRY TO QUANTITATIVE ANALYSIS. Resonant Absorption of Europium-151. Ujihira, Y. (Tokyo Univ.); Suzuki, Y.; Yokono, S. Jap. Anal.; 23: No. 4, 368-373(Apr 1974). (In Japanese).

The relationship between absorption intensity of the resonant γ of europium-151 (21.6 keV) in europium-151 and the amount of europium oxide were investigated aiming at establishing the quantitative analysis by Moessbauer spectrometry. In order to improve the precision of the resonant absorption intensity data, an attempt was made to reduce the background activity consisting of the resonant γ and induced fluorescent x rays through the use of a thin acrylate resin filter in front of a NaI(Tl) detector, and a very favorable result was obtained. The resonant absorption intensity was found to be saturated even at the 95.5 mg/cm^2 thickness of europium, or at 0.35 mm in the optical γ path of europium oxide. In order to avoid this inconvenience, an attempt was made to dilute europium oxide with chemically stable compounds. However, elements having high mass absorption coefficients to the 21.6 keV γ, such as rare earth elements, suppressed a resonant absorption intensity seriously. Energy analysis of the transmitted γ from an absorber using a high-resolution Si(Li) detector and a 200 channel pulse height analyzer elucidated that the resonant γ was attenuated by the K-shell electron of diluents. Fluorescent x rays of coexisting elements in the absorber prevailed over the resonant γ when yttrium oxide was used as a diluent. The resonant absorption intensity decreased markedly with increasing mass absorption coefficients of the diluents. Under the condition that europium was diluted with compounds having low mass coefficient absorption, such as LiF, a proportional relationship was obtained between amounts of europium and the peak intensity in the range from several to 30 ($mg\text{-}Eu/cm^2$). A correction technique is proposed for the saturated region by adopting the reduced intensity ($A_{corr.}$), which was obtained by extrapolating the experimental intensity (A) to the intensity of an ideal absorber with a zero mass absorption coefficient. In this case $A_{corr.}$ is expressed as A/k, where $k = 1.0^{(-5.24\pm0.01)\mu}$ and μ is a mass absorption coefficient. (auth)

18217 SIMPLE RECOVERY OF PLUTONIUM, AMERICIUM, URANIUM, AND POLONIUM FROM LARGE VOLUMES OF OCEAN WATER. Hodge, V. F.; Hoffman, F. L.; Foreman, R. L.; Folsom, T. R. (Scripps Institution of Oceanography, La Jolla, CA). Anal. Chem.; 46: No. 9, 1334-1336(Aug 1974).

Studies indicate that Pu, Am, U, and Po can be consistently recovered from large volumes of seawater for an α-spectrometric determination by partial precipitation of magnesium hydroxide and calcium carbonate by the addition of small amounts of sodium hydroxide. When average working recoveries are corrected for expected losses, the partial precipitation appears to carry the four elements with an efficiency of about 90%. (JGB)

18218 CHOICE OF THE MEASUREMENT GEOMETRY IN RADIOMETRIC ANALYSIS OF ORES UNDER MOTION. Igumnov, B. N.; Leonov, P. E.; T[illegible]op, A. E. (Sverdlovsk Mining Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Gorn. Zh.; No. 7, 149-153(1973). (In Russian).

X-ray dispersion as a method of monitoring ore concentrate movement was studied. Theoretical and experimental data showed that it is possible to select a geometry in which change in the height of the material on a conveyor belt has little effect on the precision of the method. An expression was obtained relating the basic parameters of the geometry of the measurement system. (tr-auth)

18219 RAPID METHOD FOR THE PREPARATION OF PLANT MATERIAL FOR LIQUID SCINTILLATION COUNTING. Shone, M. G. T.; Mercer, E. R.; Wood, A. V.; Hill, D. (Agricultural Research Council, Wantage, Eng.). Lab. Pract.; 23: No. 7, 363-364(Jul 1974).

A simple, rapid method is described for the preparation of plant material containing chlorophyll and other pigments for liquid scintillation counting. Provided the scintillator permeates the tissue, satisfactory assay of certain organic compounds labelled with ^{14}C which had entered barley shoots is demonstrated. This was achieved by bleaching the tissue in chlorine gas after which the shoots were counted whole suspended in liquid scintillator. No prior preparation of the barley plants was necessary. Evidence is presented that, with suitable modification this technique may also be applied to the assay of ^{14}C which has been incorporated in the plant tissue. (UK)

18220 SUB- AND SUPEREQUIVALENCE METHOD OF ISOTOPE DILUTION ANALYSIS. I. Principle of the Method. Klas, J. (Slovak Technical Univ., Bratislava); Toelgyessy, J.; Klehr, E. H. Radiochem. Radioanal. Lett.; 18: No. 2, 83-86 (15 Jul 1974).

The principle of sub- and superequivalence isotope dilution analysis is outlined. Two series of aliquots of the labeled sample are used; one series is isotopically diluted, the other is not. A constant amount of a selected reagent is added to each aliquot and the product is separated and counted. Isotope dilution curves are drawn and their intersection is used to calculate the concentration (or amount of material) in the sample. (auth)

Separation Procedures

18221 (FEI-390) DECREASE OF COEXTRACTION OF MICROELEMENTS IN INDIUM EXTRACTION FROM BROMIDE SOLUTIONS. Sokolov, A. B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 10p. (In Russian). INIS.

Recommendations are given for decreasing the coextraction of microelements—Zn, Te(IV), Sn(IV), Sb(III), Cd, and others—in the extraction of In from HBr solutions by diisopropyl ether. (tr-auth)

18222 EXTRACTION OF NIOBIUM THIOCYANATO COMPLEXES BY 2,9-DIMETHYL-1,10-PHENANTHROLINE. Lobanov, F. I.; Zatonskaya, V. M.; Gibalo, I. M. Vestn. Mosk. Univ., Ser. II. Khim.; 15: No. 2, 245-247(1974). (In Russian).

The extraction of niobium thiocyanato complexes from sulfuric and hydrochloric acid solutions was studied using 2% tributyl phosphate (TBP) in benzene. Optimum conditions for formation and extraction of complexes were determined. The formation and extraction of mixed ligand thiocyanato complexes of niobium with 2,9-dimethyl-1,10-phenanthroline (DMPh) were investigated also. The components ratio in the extracted associate was determined, its composition being proposed as $[NDMPh] + [NbO(OH)(CNS)_3 \cdot H_2O \cdot TBP]^-$. The association constant of mixed ligand complex Nb–NCS–DMPh extracted from sulfuric acid solutions was calculated.

18223 PAPER CHROMATOGRAPHY OF LESS COMMON METALS. Separation and Identification of Molybdenum, Vanadium and Tungsten in Solutions of Organic Acids and Their Salts. Termendzhyan, Z. Z.; Gaibakyan, D. S. (Erevan State Univ.). Arm. Khim. Zh.; 26: No. 11, 25-30(1974). (In Russian).

The separation of Mo(VI), V(V), and W(VI) ion using oxalic acid, tartaric acid, and citric acid solutions and their potassium salts in the presence of both hydrochloric acid and alkaline solutions was studied by paper chromatography. It was shown that for the separation of these ions in the mobile phase 0.0001 to 0.001 M solutions of potassium citrate can be used. (tr-auth)

18224 ABILITY OF AN ION-EXCHANGE RESIN TO RETAIN ^{137}Cs IN THE PRESENCE OF Ca^{2+} IONS AT FAST FLOW RATES. Luetzelschwab, J. W.; Gignac, C. (Dickinson Coll., Carlisle, PA). Health Phys.; 27: No. 1, 109-112(Jul 1974).

The absorption of ^{137}Cs dissolved in water that contained Ca^{2+} ions was investigated for water flowing through a Na^+-form ion-exchange resin column at flow rates between 0.3 and 1.2 l./min/cm^2. The absorption was found to be an exponential function depending on the length of the resin and an absorption coefficient. The absorption coefficient depends on the flow rate of the water and the concentration of Ca^{2+} ions in the water. The results indicate that more than 90% of the ^{137}Cs in a fresh water sample can be quickly concentrated at the sampling site using an ion-exchange column approximately 40 cm in length. (auth)

18225 STUDY ON THE BEHAVIOR OF CATIONIC RESIN AMBERLITE CG120 IN WATER-ETHANOLAMINE. Vaezy, F.; Renault, N.; Deschamps, N. (CEN de Saclay, Gif-sur-Yvette, France). Radiochem. Radioanal. Lett.; 17: No. 5-6, 381-387 (30 Jun 1974). (In French).

A study on the cation exchange of alkali metals, Cu, and Hg on Amberlite CG120 (Na^+ and $CH_2OH-CH_2-NH_3^+$ forms) in ethanolamine-water mixtures is reported. The influence of ethanolamine concentration was studied. These results allow us to know the predominant factors of this behavior, and perform chemical separations in these media. (auth)

18226 EXTRACTION OF UO_2Cl_2 WITH TRI-N-OCTYLAMINE: INFLUENCE OF SOLVENTS. Mrnka, M.; Celeda, J.; Lukavsky, J. (High School of Chemical Tech., Prague). Jad. Energ.; 20: No. 4, 113-120(Apr 1974). (In Czech).

A comparison was made of the extraction of H_2O, HCl, and UO_2Cl_2 with $CHCl_3$, CCl_4, $C_6H_5CH_3$ and $C_6H_4(CH_3)_2$ solutions of tri-n-octylamine. From chemical analysis, viscosity measurements and from ir spectroscopy of organic phase it is demonstrated that the cycles are formed. The extraction is the same in any solvent examined except in $CHCl_3$ it is less. The reason is in the competetive addition of $CHCl_3$ to the $N-H^+$ cation of the amine. (auth)

18227 STATICS OF THE SORPTION OF MOLYBDENUM ON ANIONITE AV-17. Umarakhunov, M. Kh.; Shamsiev, S. M. (Inst. of the Petroleum Refining Industry, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 2, 40-41(1974). (In Russian).

The sorption of Mo on the anionite AV-17 was studied at different concentrations of sodium molybdate. The exchange constants of the molybdate ion on the hydroxyl ion in static conditions on AV-17 were determined by shaking 1 g of the anionite with 50 ml of 0.004 to 0.1 N solutions of sodium molybdate until establishment of equilibrium. The values obtained are tabulated and show that with increase of the original concentration of the solution the concentration exchange constant increases. (JSR)

18228 EFFECT OF THE ELECTROLYTE ON THE DISTRIBUTION OF PHOSPHORUS-32 BETWEEN PHASES. Abrarov, O. A.; Zhuravlev, A. A. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 2, 26-27(1974). (In Russian).

With the purpose of clarifying the mechanism for the extraction of ^{32}P by mineral acids from paraffin, the effect of some electrolytes containing chlorine and nitride ions on the distribution of ^{32}P between phases was studied. The chlorides and nitrates of K, NH_4^+, Na, Sr, and Ca were considered. It was found that chlorides significantly reduce the distribution coefficient, but nitrate electrolytes reduce the distribution coefficient even more. The extraction of the ^{32}P into the aqueous phase is affected more as the radius of the cation is decreased. (JSR)

18229 EXTRACTION OF MOLYBDENUM WITH POLYALKYLPHOSPHONITRILIC ACID. Chernikova, L. S.; Khryaschev, S. V. Nauch. Tr., Sib. Gos. Nauch.-Issled. Proekt. Inst. Tsvet. Met.; No. 5, 155-159(1972). (In Russian).

A study was made of the use of polyalkylphosphonitrilic acid for the extraction of Mo, W, and Re from synthetic and production solutions. This acid is selective for Mo at pH 2. Although W and Re were not extracted at this pH a complete separation of Mo and W, or Mo and Re, was not achieved. The maximum saturation of the reagent with Mo from a solution of pH 1.1 was 26.6%. (Metals Abstracts)

18230 INTERACTION OF Mo AND W IN EXTRACTION FROM BROMIDE SOLUTIONS BY TRIOCTYLAMINE AND TRIOCTYLBENZYLAMMONIUM CHLORIDE. Zolotov, Yu. A.; Bagreev, V. V.; Tseryuta, Yu. S.; Agrinskaya, N. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Neorg. Khim.; 19: No. 2, 482-487(1974). (In Russian).

A relatively large amount of molybdenum affects the extraction of small amounts of tungsten from HBr solutions by tri-n-octylamine and tri-n-octylbenzylammonium chloride. The possible causes of such a phenomenon are discussed. The possibility is demonstrated of separating molybdenum from microamounts of tungsten by extraction from 0.5 or 6-8 M HBr by tri-n-octylamine of tri-n-octylbenzylammonium chloride. (tr-auth)

18231 TRIBUTYL PHOSPHATE EXTRACTION OF Zr AND Hf HYDROXYPERCHLORATES. Gavrilova, I. M.; Voronskaya, G. N.; Klyuchnikov, V. M.; Korovin, S. S.; Aprakasin, I. A. (Moscow Inst. of Fine Chemical Tech.). Zh. Neorg. Khim.; 19: No. 2, 478-481(1974). (In Russian).

Studies on extraction of Zr and Hf hydroxyperchlorates showed that the compounds are hydrolyzed in TBP and the addition of HCl to the water solution suppresses extraction. Chemical and infrared spectroscopic analysis of the extracts showed that the hydroxyperchlorates are hydrated. The ClO_4^- anion does not enter into the coordination sphere of the metal ions. The Zr and Hf salts were shown to be extracted by a hydrated salt mechanism. The high degree of Zr and Hf hydrolysis and the absence of acid residue coordination, typical of perchlorates in the TBP phase, indicate extraction of polynuclear compounds. (tr-auth)

18232 ACIDITY OF THE SOLUTION IN THE CONCENTRATION LAYER AT THE CATHODE DURING ELECTROLYTIC DEPOSITION OF Fe-Ni-Mo ALLOY UNDER CONDITIONS OF DIFFUSION CONTROL. Golubkov, L. A.; Yur'ev, B. P. (Leningrad Coke and Gas Plant). J. Appl. Chem. USSR (Engl. Transl.). Translated from Zh. Prikl. Khim.; 47: No. 1, 74-78(Jan 1974).

Study of variations of pH in the layer adjacent to the cathode during electrolytic deposition of Fe-Ni-Mo alloy from simple sulfate-molybdate solutions of moderate acidity (pH = 1.75-4.5) showed that pH_s values for iron and nickel electrodes in absence of polarization differ substantially from the pH_v values, owing to interaction of the metals with the solution. On application of cathodic polarization, pH_s increases to values in the region of 10-11.5 if $D_c > 100$ A/m^2 and $pH_v > 2$. This is due to establishment of diffusion control of reduction of Fe^{2+}, Ni^{2+}, and Mo (VI) ions, when their concentrations near the cathode fall virtually to zero. The increase of pH_s near iron electrodes after application of polarization proceeds with considerable retardation, apparently owing to reduction of molybdenum compounds of lower valence in the film which is formed on iron electrodes in absence of polarization. (auth)

18233 METHOD OF SEPARATION PLUTONIUM FROM URANIUM AND FROM OTHER TRANSURANIUM ELEMENTS. Bilal, B.; Metscher, K.; Zimen, K. E. (to Hahn-Meitner-Institut fuer Kernforschung Berlin GmbH). US Patent 3,821,091. 28 Jun 1974. Priority date 28 Jul 1971, F.R. Germany. 8p.

Plutonium is separated from uranium and other transuranium elements by subjecting an aqueous solution in dilute nitric acid of the elements to be separated to electrolytic extraction by countercurrent or cross-current ion migration in the presence of a complexing agent, preferably acetic acid or a mixture of hydrofluoric acid with an alkali metal fluoride, until plutonium and the other elements present accumulate in separate portions of the solution which are thereafter separately withdrawn. (Official Gazette)

18234 PROCESS FOR SEPARATION OF YTTRIUM FROM THE LANTHANIDES. Gaudernack, B.; Hannestad, G.; Hundere, I. (to Forskningsgruppe for Sjeldne Jordarter). US Patent 3,821,352. 28 Jun 1974. Priority date 20 Jul 1971, Norway. 12p.

An improved liquid-liquid extraction process for the separation of yttrium values from the elements of the lanthanide series and other impurities is disclosed. The light lanthanide elements are separated by extraction from an aqueous nitrate solution with an organic solution of a quaternary ammonium nitrate, and the heavy lanthanides are subsequently removed from the aqueous solution by extraction with an organic solution of a quaternary ammonium thiocyanate. (Official Gazette)

18235 EXTRACTION OF TRIVALENT TRANSPLUTONIUM ELEMENTS AND EUROPIUM FROM HIGHLY ACIDIC MEDIA. Myasoedov, B. F.; Chmutova, M. K.; Kochetkova, N. E.; Pribylova, G. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Dokl. Chem.; 213: No. 1-3, 885-887(Nov 1973).

Translated from Dokl. Akad. Nauk SSSR; 213: No. 3, 597-599 (Nov 1973).

A mixture of di-2-ethylherylorthophosphate (D2EHP) and phosphorus pentoxide was used to extract Am, Cm, Bk, Cf, and Ev from HNO_3, HCl, H_2SO_4, and $HClO_4$ media. Extraction of the elements increased with an increase in D2EHP and P_2O_5 concentration. The mechanism of the extraction is not discussed. (LK)

18236 STUDIES ON THE DEGREE OF CATION EXCHANGE OF SODIUM IN NaY ZEOLITES BY MEANS OF RADIOACTIVE TRACERS. Grzelewski, L.; Krawczyk, N. (Zaklad Syntezy Kontaktowej Instutu, Warsaw). Przem. Chem.; 53: No. 5, 290-292(May 1974). (In Polish).

The method of radioactive tracers was applied to determine the degree of exchange of sodium cations in NaY zeolite for neodymium cations, in relation to temperature and duration of the process, neodymium ion concentration in the solution, and exchange ratio for the same zeolite sample. For this purpose NaY zeolite was traced with radioactive sodium ^{22}Na by way of ion-isotope exchange. The results were checked by other methods. (auth)

18237 SEPARATION AND DETERMINATION OF THE TRANSPLUTONIUM ELEMENTS. I. Ch'en, K. C. Hua Hseuh Tung Pao; No. 2, 31-40(23 Mar 1974). (In Chinese).

The theoretical background, the various complexing and eluting agents, and anion and cation exchange resins in mutual separation, separation from the rare earth elements, and separation from uranium and plutonium of the transplutonium elements by ion exchange, solvent extraction and electrophoresis techniques are discussed. Other separation techniques, such as precipitation, paper chromatography and gas chromatography are also reviewed and discussed. (JPRS)

18238 JOINT CEMENTATION (PRECIPITATION) OF Cr, V, Al, Zr, AND Mn BY METALLIC TITANIUM IN TITANIUM-CONTAINING CONCENTRATED CHLORIDE MELTS. Ivanov, I. I.; Sandler, R. A.; Shirokova, V. F.; Yakselyainen, E. I.; Gulyakin, A. I. J. Appl. Chem. USSR (Engl. Transl.); 47: No. 1, 69-73 (Jan 1974).

Translated from Zh. Prikl. Khim.; 47: No. 1, 68-74(Jan 1974).

In joint precipitation of Al with Cr, V, Zr, and Mn the degree of purification of melts is determined by the electrochemical activity of the coprecipitated elements. The use of metallic magnesium for coprecipitation of Al with other elements is effective only when the impurity contents of the melts are low. The degree of purification of concentrated titanium-containing chloride melts by joint precipitation of impurity elements by addition of titanium is determined by the degree of approach to equilibrium between the contents of lower titanium chlorides in the melt. (auth)

18239 LIQUID-LIQUID EXTRACTION OF PENTAVALENT AMERICIUM BY 1-PHENYL-3-METHYL-4-BENZOYLPYRAZOLONE-5. Myasoedov, B. F.; Molochnikova, N. P. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Radiochem. Radioanal. Lett.; 18: No. 1, 33-42(2 Jul 1974).

The extraction of Am(V) by solutions of 1-phenyl-3-methyl-4-benzoylpyrazolone-5 (PMBP) in various solvents has been investigated. It has been found, that the quantitative extraction of Am(V) by 0.05M PMBP solution in isobutanol occurs at pH 4.5-5.5. The composition of the chelate compound extracted is AmO_2 (PMBP) × 3S, where S is isobutanol. Am(V) reduced rapidly to Am(III) by PMBP in the organic phase. (auth)

18240 SEPARATION OF THE OXYANIONS OF Re(VII), Mo(VI), Cr(VI), W(VI), AND V(V) FROM A MULTICOMPONENT SOLUTION AT pH 6 BY FOAM FRACTIONATION. Charewicz, E.; Grieves, R. B. (Univ. of Kentucky, Lexington). Anal. Lett.; 7: No. 4, 233-241(Apr 1974).

An experimental investigation is presented of the foam separation of the oxyanions of Re(VII), Mo(VI), Cr(VI), W(VI), and V(V). The pH 6.0, multicomponent aqueous solutions are 1.0×10^{-6}M in each metal. The effect of chloride competition with the metal oxyanions for the cationic surfactant is determined with NaCl concentrations up to 0.3M. With proper NaCl concentration adjustments, V(V) can be separated completely from the other four metals, and Re(VII) and Mo(VI) from the other three. Pulsed surfactant is investigated for 1.0×10^{-6}M Mo(VI) solutions at pH 6.0 and 3.1. (auth)

18241 LIQUID-LIQUID EXTRACTION OF ARSENIC(III)-DIETHYL DITHIOCARBAMATE. Stary, J.; Prasilova, J. (Technical Univ., Prague). Radiochem. Radioanal. Lett.; 18: No. 2, 99-105(15 Jul 1974).

Arsenic(III) can be extracted from sulfuric acid containing potassium iodide into arsenic(III)-diethyl dithiocarbamate (AsA_3) in carbon tetrachloride in the form of two mixed complexes $AsIA_2$ and AsI_2A. The equilibrium concentrations of both these species as well as of AsI_3 were calculated from the experimental results. (auth)

18242 FIXING CATION INTERACTION WITH BLISTER-LIKE OSMOTIC SWELLING ON VERMICULITE CLEAVAGES. Sridhar, K.; Jackson, M. L. (Univ. of Wisconsin, Madison). Clay Miner.; 21: 369-377(1973). (COO-1515-42).

The shrinkage of osmotically swollen natural and artificial blisters on vermiculite cleavages by exchange saturation with fixing cations such as Cs^+, Rb^+, NH_4^+, and K^+ was investigated by replica electron microscopy. Incomplete collapse of either the natural or artificially produced blisters occurred with Cs^+, Rb^+, and NH_4^+ saturation, while K^+ saturation completely collapsed the artificially produced blisters but not the natural blisters. The reason for incomplete collapse with Cs^+, Rb^+ and NH_4^+ was the incomplete replacement (trapping in the flakes) of interlayer hydrated cations such as Na^+, shown by electron probe microanalysis. Much less trapping occurred with K^+ saturation. Na^+ entrapment increased with increasing size and decreasing hydration of cations, i.e. $Cs^+ > Rb^+ > NH_4^+ > K^+$. Semiquantitative determination of Na^+, by electron probe microanalysis, in vermiculite flakes near the edge revealed that 1 N CsCl entrapped as much as 45.6 per cent while 1 N KCl entrapped only 7.5 per cent. In general, more Na^+ was entrapped by 1 N solutions than by dilute solutions. With 0.01 N KCl solution, the Na^+ entrapment was only 4.4 per cent. The amount of Na^+ at the center of the macroflakes was less than at the edge, apparently as a result of more CEC at frayed edges and (or) because of incomplete diffusion of Na^+ to the center. Shrinkage of artificial blisters by K^+ could thus be attributed to its more effective removal of the interlayer hydrated cations, whereas the other fixing cations were less effective. Natural blisters on vermiculite from Libby, Montana were not completely collapsed even by K^+, apparently because the layer charge density was too low in the blister areas. (auth)

18243 APPLICATION OF MACROPOROUS STYRENE-DIVINYLBENZENE COPOLYMER WITH FUNCTIONAL AMINO GROUPS IN THE CAPTURE AND FIXING OF GASEOUS RADIOACTIVE IODINE AND ITS COMPOUNDS. Cejnar, F. Czech Patent 146,453. 15 Dec 1972. Filed date 21 Jan 1972. 2p.

Vapors of radioactive iodine and its compounds, such as hydrogen iodine or methyl iodide, may be captured on macroporous copolymers such as styrene-divinylbenzene copolymers, whose pore structure facilitates the reaction. The functional amino groups ensure a high efficiency of the material in contact with the gaseous phase. Radioactive iodine and its compounds are chemically firmly bound and are built into the structure of the copolymer. They cannot be eluted during the passage of the atmosphere contaminated with a gaseous radioactive substance. (Nuclear Sci. Abstr. Czech.)

Inorganic, Organic, and Physical Chemistry

18244 THEORETICAL ANALYSIS OF THE SHOCK COMPRESSION EXPERIMENTS OF THE LIQUID HYDROGEN ISOTOPES AND A PREDICTION OF THEIR METALLIC TRANSITION. Ross, M. (Univ. of California, Livermore). J. Chem. Phys.; 60: No. 9, 3634-3644(1 May 1974).

Shock compression experiments in which the liquid hydrogen isotopes were compressed as much as sevenfold in density to pressures of the order of 900 kbar are analyzed to obtain an effective intermolecular potential. Because temperatures as high as 7000°K are generated during the shock process, this potential is most accurate in the highly repulsive, small separation region, and is thereby well suited to calculate the properties of dense molecular hydrogen in the region of the metallic transition. By equating the Gibbs free energies of the metal and molecular phases, we calculate the pressure and density of the metallic transition. Unfortunately, the large experimental error and the sensitivity of the transition to the free energy allows us only to estimate a lower bound of 2 to 3 Mbar for the transition pressures. (auth)

Chemical and Physicochemical Properties

Refer also to abstracts 18188, 18352, 18354, 18871, 19115, 19177, 19181, 19186, 19248, 20536, and 20537.

18245 (ARH-2862) HEAT OF COMBUSTION OF SOLVENTS USED IN NUCLEAR FACILITIES. Kindle, C. H. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Feb 1974. Contract AT(45-1)-2130. 17p. Dep. NTIS $4.00.

An adiabatic bomb calorimeter was used to measure the heat of combustion of hexone, normal paraffin hydrocarbon (NPH), tributyl phosphate (TBP), dibutylbutyl phosphonate (DBBP), and di(2-ethylhexyl) phosphoric acid (D2EHPA) and certain of their

mixtures. The effects of pressure, temperature, solvent mixing, water, and dilute acid contact on the heat of combustion are briefly discussed. (auth)

18246 STUDY OF ANODIC DISSOLVING OF MOLYBDENUM AT HIGH CURRENT DENSITIES. Davydov, A. D.; Kashcheev, V. D.; Kriven'kii, V. P. Elektron. Obrab. Mater.; No. 1, 5-8 (1973). (In Russian).

The anodic dissolution of rotating disc Mo electrodes in solutions of different composition was studied. The effect of the rotation rate of the electrodes, the anion composition, pH, and temperature of the solution on the possibility of obtaining a high current density was explained. (tr-auth)

18247 INVESTIGATION OF ANODE DEPOSITION OF TUNGSTEN ON GRAPHITE FROM AQUEOUS SOLUTIONS WITH RADIOACTIVE TRACERS. Kirin, I. S.; Ivachenko, A. F. Sov. Radiochem. (Engl. Transl.); 15: No. 4, 572-577(1973).

Translated from Radiokhimiya; 15: No. 4, 569-575(1973).

Anodic electrodeposition of tungsten on a graphite electrode from neutral aqueous solutions in the range of tungsten concentrations from 10^{-5} to 10^{-2} g-atom/liter was investigated. Two methods of determining the critical potential of tungsten, namely, from the relation of the change in the activity of the electrode to the potential and from "current-potential" curves, were shown to be of different value. The kinetics of anodic deposition of tungsten were investigated at a potential of +1.4 V relative to a NHE. From experimental results obtained using ^{181}W as tracer studies of the effect of the tungsten concentration on the critical potential it was shown that the electrochemical reaction has a three-electron mechanism and leads to the deposition on the electrode of tungsten peroxide with the probable composition WO_4. With 1 N potassium chloride as the base electrolyte and a pH of 6-7 the formal standard potential of the electrochemical process equals +0.765 ± 0.005 V. The different forms of the relation of the critical potential to the tungsten concentration in different concentration ranges are explained. The results of the potentiometric investigations were confirmed by experiments to establish the distribution of tungsten between the electrode and the solution under definite electrolysis conditions. (auth)

18248 SUPPLEMENT TO THE NEW TREATISE OF INORGANIC CHEMISTRY. Volume 1. Rubidium, Cesium, and Francium. Pascal, P. Paris; Masson (1974). 117p. (In French).

The chemical properties of rubidium, cesium, and francium are presented in this manual. Nuclear properties and method for the separation of francium are also presented. An extensive bibliography is given. (FR)

18249 USE OF RADIOLABELLED T_1 RIBONUCLEASE TO MONITOR THE EFFICIENCY OF EDMAN DEGRADATIONS. McKean, D. J.; Smith, G. P. (Wisconsin Univ., Madison). Biochem. J.; 139: No. 3, 779-780(Jun 1974).

A simple radiolabel tracer method is presented for monitoring the efficiency of the first ten cycles of an Edman degradation. This method consists of adding a very small amount of radiolabelled S-carboxymethylated T_1 ribonuclease to the protein to be sequenced, and counting the radioactivity of a small sample from each of the degradative cycles. (auth)

Isotope Effects

Refer also to abstracts 18285, 18298, and 18356-18358.

18250 ISOTOPE EFFECT STUDIES ON ELIMINATION REACTIONS. IX. The Nature of the Transition State for the E2 Reaction of 2-Arylethylammonium Ions with Ethoxide in Ethanol. Smith, P. J.; Bourns, A. N. (McMaster Univ., Hamilton, Ont.). Can. J. Chem.; 52: No. 5, 749-760(1 Mar 1974).

Kinetic isotope effects were determined for the E2 reaction of some 2-arylethyltrimethylammonium ions with ethoxide in ethanol at 40°C. The nitrogen effect, $(k^{14}/k^{15} - 1)100$, decreased with increasing electron-withdrawing ability of the para substituent (i.e., 1.37, 1.33, 1.14, and 0.88 for p-OCH_3, p-H, p-Cl, and p-CF_3, respectively). Furthermore, the primary hydrogen-deuterium isotope effects increased for the same substituents, respectively; i.e. k^H/k^D = 2.64, 3.23, 3.48, and 4.16. A large positive ρ value of 3.66 was found as well as a small secondary α-deuterium effect of 1.02 for p-H. In addition, the nitrogen effect decreased with increasing strength of the abstracting base for the reaction of ethyltrimethylammonium ion (i.e., 1.86 and 1.41 at 60° for reaction with EtO^--EtOH and t-BuO^--t-BuOH, respectively). The results are discussed in terms of recent theoretical treatments of the effect of base, substituents, and nature of the leaving group on the nature of the transition state for an E2 process. The conclusion is reached that any structural change which causes one bond (C-H) to be weakened more at the transition state will have a corresponding effect on the other bond (C-N). (auth)

18251 PRESSURE DEPENDENCE OF THE DIELECTRIC CONSTANT OF H_2O AND D_2O. Srinivasan, K. R.; Kay, R. L. (Carnegie-Mellon Univ., Pittsburgh). J. Chem. Phys.; 60: No. 9, 3645-3649(1 May 1974).

The static dielectric constant of H_2O and D_2O were measured at 10, 25, and 40°C at pressures up to 3 kbar by a bridge method. An all-glass, three-terminal, Kay-Vidulich-type dielectric cell was designed specifically for these high pressure measurements and was used in conjunction with a bridge that was equipped with a capacitance-inductance free, conductance balancing network. The structurally significant quantities $g_K \mu^2$ and g_K, the Kirkwood correlation factor, were evaluated from the experimental data and the Frölich equation. Their pressure dependence and the structural implications are analyzed in detail. (auth)

18252 ISOTOPE EFFECTS ON THE VAPOR PHASE SECOND VIRIAL COEFFICIENTS OF THE DEUTERATED METHANES. Fang, A. Y.; Van Hook, W. A. (Univ. of Tennessee, Knoxville). J. Chem. Phys.; 60: No. 9, 3513-3522(1 May 1974).

Isotope effects on the second virial coefficients of CH_4, CH_3D, CH_2D_2, CHD_3, and CD_4 were measured between 110 and 300°K, by a differential expansion technique. The isotope effects obeyed the law of the mean to within the experimental precision (about ±0.2 cc/mole). That for CD_4/CH_4 is given by $B(CD_4)-B(CH_4)$ = (2.08 ± 0.14) + (399.8 ± 24.2)/T. $\Delta B/B$ amounts to approximately 2% at 110°K increasing to 9% at 300°K. Analysis indicates that the most important contribution to the virial coefficient isotope effect is due to the isotope effect on the molecular polarizability. The value for this effect extracted from the data is consistent with that derived by other methods. The effects correspond to isotopic differences on the Lennard-Jones constants of $(\sigma_{CH_4} - \sigma_{CD_4})/\sigma_{CH_4} = -0.013 \pm 0.005$ and $(\epsilon_{CH_4} - \epsilon_{CD_4})/\epsilon_{CH_4} = 0.005 \pm 0.005$. These are shown to be consistent with isotope effects on intramolecular C-H and CD bond lengths via a simple model calculation. Consistency with condensed phase molar volume isotope effects is also demonstrated. (auth)

18253 INTERMOLECULAR ENERGY TRANSFER IN LIQUID BENZENE: RAMAN SPECTRA, LINEWIDTH MEASUREMENTS, PICOSECOND SPECTROSCOPY, AND VIBRATIONAL RELAXATION TIMES. Griffiths, J. E.; Clerc, M.; Rentzepis, P. M. (Bell Labs., Murray Hill, NJ). J. Chem. Phys.; 60: No. 10, 3824-3830(15 May 1974).

A collision-induced intermolecular vibrational energy transfer process in liquid C_6H_6 was studied using detailed measurements of Raman line shapes and linewidths and picosecond spectroscopy. Lifetimes of molecules in the upper vibrational energy level of the Raman transition $\nu_2(\nu = 0-1)$ in C_6H_6 and C_6D_6 were evaluated using both frequency and time measurements. By varying the absolute number of $C_6H_6-C_6H_6$ collisions over a wide range by dilution of C_6H_6 with C_6D_6, the lifetime of the ν_2' state can be altered from $4.7-7.0 \times 10^{-12}$ sec. The higher value corresponds to an intrinsic lifetime of ν_2' in the liquid state while the other is a lower value because of a near resonance collision induced intermolecular vibration energy transfer process, which occurs in pure C_6H_6. Direct measurement of the $\nu_2(a_{1g})$ vibrational lifetimes by picosecond spectroscopy gives values of 5×10^{-12} sec for pure liquid C_6H_6 and 9×10^{-12} sec for pure liquid C_6D_6. (auth)

18254 HIGH RESOLUTION PHOTODETACHMENT STUDY OF OH^- AND OD^- IN THE THRESHOLD REGION 7000 TO 6450 Å. Hotop, H. (Univ. of Colorado, Boulder); Patterson, T. A.; Lineberger, W. C. J. Chem. Phys.; 60: No. 5, 1806-1812(1 Mar 1974).

The photodetachment of OH^- and OD^- ions was studied in the range 7000-6450 Å, utilizing a tunable, narrow-bandwidth (0.5-1 Å) dye laser as the light source. A detailed comparison of the observed cross section with model calculations is made, yielding the following results: E.A.(OH) = (14,723 ± 15) cm^{-1}, E.A.(OD) = (14,703 ± 15) cm^{-1}. The observed isotope effect for the electron affinity can be ascribed almost entirely to differences in the position of the ground rotational state in $OH(^2\Pi_i)$ and $OD(^2\Pi_i)$; the implications of this result for the vibrational frequency of the negative ions are discussed. The energy dependence of the observed cross section indicates the influence of the electron-permanent dipole moment interaction in the final channel on the threshold behavior, which is found to be sharper than that expected in the absence of such an interaction. (auth)

18255 RAMAN SPECTRA OF GASES. XI. Methyl Torsional Overtones in the Ethyl Halides. Durig, J. R.; Bucy, W. E.; Carreira, L. A.; Wurrey, C. J. (Univ. of South Carolina, Columbia). J. Chem. Phys.; 60: No. 5, 1754-1757(1 Mar 1974).

A series of peaks in the Raman spectra of gaseous CH_3CH_3, CH_3CH_2Cl, CH_3CH_2Br, CH_3CD_2Br, CD_3CH_2Br, CD_3CD_2Br, CH_3CH_2I, CH_3CD_2I, and CD_3CH_2I were observed and assigned to the torsional overtones, ($\Delta\nu = 2$) of the methyl group. From these spectroscopic data, barriers to internal rotation were calculated for the ethyl halides. For the compounds where the barriers are accurately

known from previous work, the values obtained in this study agree quite well. The value for the internal rotational barrier in ethyl iodide is 3.67 ± 0.01 kcal/mole, which is considerably higher than the value previously reported from microwave studies. It is shown that Raman spectroscopy can be a convenient technique for obtaining torsional barrier heights when one uses the $\Delta\nu = 2$ quantum jumps of the torsional motion. (auth)

18256 KINETICS AND MECHANISMS OF REACTIONS OF 3-BUTEN-2-ONE AND RELATED COMPOUNDS IN AQUEOUS PERCHLORIC ACID. Jensen, J. L.; Carre, D. J. (California State Univ., Long Beach). J. Org. Chem.; 39: No. 14, 2103-2107 (12 Jul 1974).

A detailed study of the hydration of homologs of 3-buten-2-one is reported. Rate constants for the hydration and dehydration reactions were separated and activation parameters, precise solvent isotope effects, and acidity dependences were measured over a wide range of acidity, 1–10 M perchloric acid. These mechanistic criteria are discussed in view of other olefin hydrations. (auth)

18257 HYDRATED PROTON $H^+(H_2O)_n$. II. A Spectroscopic Study and Normal Coordinate Treatment of the Oxonium Ions H_3O^+ and D_3O^+. Basile, L. J.; LaBonville, P.; Ferraro, J. R.; Williams, J. M. (Argonne National Lab., IL). J. Chem. Phys.; 60: No. 5, 1981-1987(1 Mar 1974).

A spectroscopic study and a normal coordinate treatment (NCT) of the oxonium ions H_3O^+ and D_3O^+ in solid $H_3O^+CH_3C_6H_4SO_3^-$ and $D_3O^+CH_3C_6H_4SO_3^-$ were made. Neutron diffraction studies indicated a pyramidal, C_{3v} symmetry for the oxonium ions. Based on this symmetry, the observed frequencies for H_3O^+ and D_3O^+ were assigned and a NCT attempted using the general valence force field and the Urey–Bradley force field. Comparison of the fundamental vibrations in various oxonium compounds was made. It was demonstrated that a relationship between the OH stretching frequencies in H_3O^+ and D_3O^+ ions vs R (the O ··· O distance) exists, as well as a relationship between the stretching frequency shift ($\Delta\nu_s$) and R. The failure of past investigators to recognize this trend may have contributed to the confusion regarding the assignments. This is the first confirmation of such a trend existing in oxonium compounds. It is suggested that the stretching mode frequencies in H_3O^+ and D_3O^+ are dependent on R. When $_{x-y}$ is greater than the X–H ··· Y van der Waals radius sum, the asymmetric stretching vibration (ν_3, e) is at higher frequency than the symmetric stretching vibration (ν_1, a_1); where R_{x-y} is less, the stretching mode-frequencies are inverted. (auth)

18258 MASS SPECTRA OF DIPHENYLMERCURY AND DIBENZYLMERCURY. Druzhkov, O. N.; Andrianov, Yu. A.; Petukhov, G. G. (Gorky State Univ., USSR). J. Gen. Chem. USSR (Engl. Transl.); 44: No. 2, 307-313(Feb 1974).

Translated from Zh. Obshch. Khim.; 44: No. 2, 322-330(Feb 1974).

A study was made of the mass spectra of ordinary and deuterated diphenylmercury $(C_6H_5)_2Hg$, and $(C_6D_5)_2Hg$ and of dibenzylmercury $(C_6H_5CH_2)_2Hg$ at various electron energies, emission currents, temperatures and rates of admission. Schemes of dissociation under electron impact are given. It was shown that in the instrument the pyrolytic and catalytic decomposition of these compounds occurs on the surface of various parts of the ion source with formation of mercury, R–R, and RH (in which R = C_6H_5, C_6D_5, and $C_6H_5-CH_2$). In the pyrolysis mainly mercury is formed. In the formation of benzene in the catalytic reaction hydrogen atoms from the surface take part. The spectra of the substances formed are superimposed on the spectra of the organomercury compounds. It was established that the presence of intense peaks of organic ions in the spectra of the compounds studied does not arise from pyrolysis processes on the incandescent cathode, but is determined by the action of electron impact. (auth)

18259 STABLE ISOTOPES OF OXYGEN IN RESEARCH AND TECHNICAL APPLICATIONS. Staschewski, D. (Kernforschungszentrum, Karlsruhe, Ger.). Angew. Chem. Int. Ed. Engl.; No. 6, 357-370(Jun 1974).

The stable isotopes of oxygen have proved to be efficient research tools; however, only a small fraction of the possible applications of these isotopes have been examined so far. The present progress report deals with five basic types of isotopic effects whose investigation and evaluation offer information of a new kind about physical, chemical, and biological systems and processes. (auth)

18260 ISOTOPE SHIFTS IN THE ARC SPECTRUM OF XENON. Jackson, D. A.; Coulombe, M. C. (Centre National de la Recherche Scientifique, Orsay, France). Proc. Roy. Soc. (London), Ser. A; 338: No. 1614, 277-298(28 Jun 1974).

Isotope shifts have been measured in the lines of the spectrum xenon I for all of the nine stable isotopes. For the five more abundant (heavier) isotopes of even mass number the measurements include 37 lines in the visible and the photographic infrared; but for the lightest isotopes ^{126}Xe and ^{124}Xe measurements could be made only in respectively 3 and 12 lines, on account of the very small amounts of enriched isotopes which were available. For the isotopes of odd mass-number precise measurements could be made only when the hyperfine structures were resolved. This was possible for 22 lines of ^{129}Xe, which has a nuclear spin of $\frac{1}{2}$ with correspondingly simple hyperfine structures but for only 10 lines of ^{131}Xe, which has a nuclear spin of $\frac{3}{2}$ with more complex hyperfine structures, with much narrower separations. The lines for which isotope shifts were measured were (with two exceptions) due to transitions either between the electron configurations $5p^5$, 6 or 7p and $5p^56s$ or the configurations $5p^5$, 6, 7, 8, or 9d and $5p^46p$. The shifts in 24 lines due to the first type of transitions are invariably in the opposite sense to the Bohr shift and from two to six times greater while those in 11 lines due to the second type of transitions are in the same sense as the Bohr shift, and two to three times greater. The isotope shifts show departures from a linear relation between the neutron number and the isotope shift which resemble those found in lines of barium and cesium. The large number of lines in which isotope shifts have been measured permits an extensive test of the hypothesis that the ratio of the field-shifts of the isotopes should be constant in all lines; the validity of this hypothesis is confirmed. (auth)

18261 THERMODYNAMICS OF SOLUTIONS OF RbH_2PO_4 AND RbD_2PO_4 IN H_2O AND D_2O. Vorobveb, A. F.; Monaenkova, A. S.; Mishchenko, A. V.; Rashkovich, L. N. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 17: No. 5, 673-676(1974). (In Russian).

The enthalpy of dissolution of RbH_2PO_4 in D_2O, RbD_2PO_4 (70% deuterium) in H_2O, and RbD_2PO_4 (90% and 99% deuterium) in D_2O and the solubility of RbH_2PO_4 in H_2O and RbD_2PO_4 (80% deuterium) in D_2O were measured in the temperature interval from 16 to 50°C. The results showed that increase of the degree of deuteration of the salt led to reduction of the enthalpy of its dissolution in D_2O but to an increase of the enthalpy of dissolution in H_2O. The solubility of RbD_2PO_4 in D_2O was much larger than that of RbH_2PO_4 in H_2O. The reasons for these differences were discussed in detail. (JSR)

18262 MASS SPECTROMETRIC STUDIES USING COMPOUNDS ISOTOPICALLY LABELED AT NATURAL ABUNDANCE: A DEVELOPMENT FROM ION KINETIC ENERGY SPECTROMETRY. Beynon, J. H.; Brothers, D. F.; Cooks, R. G. (Purdue Univ., West Lafayette, IN). Anal. Chem.; 46: No. 9, 1299-1302(Aug 1974).

The application of ion kinetic energy spectrometry to analysis of naturally labeled compounds is illustrated. Kinetic isotope effects and isotope effects upon kinetic energy release are reported for n-butane labeled with ^{13}C. (auth)

18263 ADVANCES IN PHYSICAL ORGANIC CHEMISTRY. Volume 10. Gold, V. (ed). New York; Academic Press Inc. (1973). 248p.

The five sections include discussions on experiments on the nature of steric isotope effects (abstracted separately for NSA), the reactivity of carbonium ions toward carbon monoxide, chemically induced dynamic nuclear spin polarization and its application, the photochemistry of carbonium ions, and physical parameters for the control of organic electrode processes. A separate abstract was prepared for one section. (JGB)

For an abstract of an individual chapter see: 18264.

18264 EXPERIMENTS ON THE NATURE OF STERIC ISOTOPE EFFECTS. Carter, R. E. (Lund Inst. of Tech., Sweden); Melander, L. Advan. Phys. Org. Chem.; 10: 1-27(1973).

Steric isotope effects, which may be ascribed to differences in effective size of isotopic atoms, are discussed as to theory and experimental studies. A detailed exposition of Bartell's perturbation treatment and an alternative model based on somewhat different assumptions about timing in the transition state are presented. A selective noncomprehensive review of other experimental work in the field is also presented. (41 references) (JGB)

18265 PRESSURE DEPENDENCE OF VISCOSITY AND NUCLEAR RELAXATION TIME IN WATER AND DEUTERIUM OXIDE. O'Reilly, D. E. (Argonne National Lab., IL). J. Phys. Chem.; 78: No. 16, 1674-1675(1 Aug 1974).

The pressure dependence of viscosity and nuclear relaxation times in water and deuterium oxide may be readily explained in terms of a new model for water that was formulated. Effective values of the deuteron quadrupolar coupling constant in D_2O are given. (auth)

18266 KINETICS OF RECOMBINATION OF ATOMIC HYDROGEN AND DEUTERIUM. Azatyan, V. V.; Borodulin, R. R.;

Intezarova, E. I. (Inst. of Chemical Physics, Moscow). Dokl. Phys. Chem.; 213: No. 4-6, 1053-1055(Dec 1973).

Translated from Dokl. Akad. Nauk SSSR; 213: No. 4, 856-859 (Dec 1973).

A method of studying the kinetics of simultaneously occurring quadratic and linear atom recombinations under jet conditions is described and illustrated in the case of the recombination reactions of H and D in the presence of Ar or He. The procedure proposed is based on varying the linear velocity of the jet as a constant reaction zone length thus making it possible to eliminate the effect of the different effectiveness of heterogeneous recombinations in various parts of the reaction vessel. The equation describing the kinetics in the concentration of the free atoms was derived. In all experimental results the left part of the equation has a linear dependence on p^2 (p number of particles/cm^3). The rate constants calculated from the experimental data by the kinetic equation are tabulated and the kinetic isotope effects corresponding to these rate constants are given. The values obtained are in agreement with previous studies on heterogeneous recombinations, but not with homogeneous recombinations. (JSR)

18267 APPARENT MOLAL VOLUMES AND HEAT CAPACITIES OF UREA AND METHYL-SUBSTITUTED UREAS IN H_2O AND D_2O AT 25 DEGREES C. Philip, P. R.; Perron, G.; Desnoyers, J. E. (Univ. de Sherbrooke, Quebec). Can. J. Chem.; 52: No. 9, 1709-1713(1 May 1974).

The apparent molal volumes and heat capacities of urea, 1,1- and 1,3-dimethylurea, and tetramethylurea were measured in H_2O and D_2O at 25°C. From these data, urea water interactions seem to cause an overall structure-breaking effect and the substituted ureas, an overall structure-making effect. The effect of the hydrogen-bonding interactions to the volume and heat capacity seems to be small compared with the intrinsic and hydrophobic contributions of a methylene group, as reflected by the isotope effect. Furthermore, transfer values seem to show a significant specificity to the degree and position of methyl substitution. (auth)

18268 DETERMINATION OF ATOMIC EIGENVECTOR MAGNITUDES BY ISOTOPIC SUBSTITUTION. Elcombe, M. M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). J. Phys., C (London); 7: No. 11, L202-L205 (7 Jun 1974).

The magnitude of eigenvector components can be obtained directly from isotopic frequency shifts. The theory, to first-order approximation, is given. The result is tested by calculations on normal ($Zn^{32}S$) and substituted ($Zn^{34}S$) cubic zinc sulfide. The accuracy and usefulness of the result is assessed. (auth)

18269 MECHANISTIC STUDY OF THE OXIDATION OF PTERIDINE DERIVATIVES. Oyama, K. Vancouver, Canada, Univ. of British Columbia (1973). National Library of Canada, Ottawa.

Thesis (Ph.D.).

The permanganate oxidation of 6,7,8-trimethyllumazine (TML) was investigated and its mechanism was elucidated by means of kinetic and product studies. The oxidations of 6,7-diphenyl-8-methyllumazine with permanganate and of TML with potassium trans-1,2-diaminocyclohexanetetraacetatomanganate(III) (KMn^{III}CyDTA, where CyDTA represents the ligand) were also studied, as an aid in understanding the oxidation process. It was found that permanganate oxidation of TML consists of a permanganate-independent path and permanganate-dependent path. The former is subject to general base catalysis by the phosphate buffer species above pH 3.5, with the rate being almost identical with that for the hydrogen-deuterium exchange reaction of the 7-methoyl group of TML multiplied by a factor of three. A kinetic isotope effect of 6.89 at 31.4°C was obtained for TML deuterated at the 7-methyl group. From these results it was concluded that the initial step of the reaction is rate-determining removal of a proton by attack of general bases at the 7-methyl group to produce an enolate-anion. The permanganate-independent path below pH 3.5 is subject to general acid catalysis by hydronium ion as well as by the phosphate buffer species. The oxidation is somewhat faster than the exchange and a kinetic isotope effect of 2.46 at 31.4°C was obtained for TML deuterated at the 7-methyl group. These facts were explained by assuming the presence of an hydration route as well as the enolization route. The permanganate-dependent path was found to be subject to specific acid catalysis and there was no kinetic isotope effect for the 7-CD_3 compound. (Diss. Abstr. Int., B)

Isotope Exchange and Isotope Separation

Refer also to abstract 18300.

18270 NATURE OF THE ESR SIGNALS PRODUCED ON UV IRRADIATION OF SILICA GELS CONTAINING ADSORBED OXYGEN. Surin, S. A.; Nikisha, V. V.; Shelimov, B. N.; Kazanskii, V. B. (Inst. of Organic Chemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 8: No. 1, 34-38(1974).

Translated from Khim. Vys. Energ.; 8: No. 1, 43-48(1974).

The photoinduced ESR signals produced in silica gels containing adsorbed oxygen at 77°K were investigated. Signals with the g factors $g_1 = 2.008$, $g_2 = 2.0045$, and $g_3 = 2.003$ were ascribed to O_3^- anion radicals. These radicals are stable at –196°C and decompose via the reaction $O_3^- \rightarrow O^- + O_2$ on increasing the temperature to –100°C. It was shown that the activity of irradiated silica gels with respect to the homomolecular isotope exchange of oxygen correlates qualitatively with the intensity of the ESR signal due to O_3^-. (auth)

18271 EXPERIMENTAL THERMAL DIFFUSION FACTORS FOR $^{20}Ne-^{22}Ne$ AND THEIR APPLICATION AS A TEST OF THE NEON INTERATOMIC POTENTIAL. Taylor, W. L.; Weissman, S. (Monsanto Research Corporation, Miamisburg, OH). J. Chem. Phys.; 60: No. 9, 3684-3689(1 May 1974).

The thermal diffusion factor of $^{20}Ne-^{22}Ne$ was measured from approximately 200 to 900°K in a 20-tube trennschaukel. The results of previous workers were examined in detail, and those considered the most reliable were combined with the present data and fitted to a polynomial in powers of $T^{\frac{1}{2}}$. The resulting expression represents existing thermal diffusion data from 75 to 1200°K with an average standard deviation of ±3.1%. Eighteen intermolecular potentials for neon of various functional forms were investigated, but none was found that produced a satisfactory theoretical value for α_r over the entire temperature range. (auth)

18272 ISOTOPIC PARTITION FUNCTION RATIOS INVOLVING H_2, H_2O, H_2S, H_2Se AND NH_3. Bron, J.; Chang, C. F.; Wolfsberg, M. (Univ. of California, Irvine). Z. Naturforsch., A; 28: No. 2, 129-136(Feb 1973).

Ideal gas phase isotopic partition function ratios involving both deuterium and tritium substitution for hydrogen and also heavy atom substitution in H_2, H_2O, H_2S, H_2Se, and NH_3 have been calculated at a number of temperatures. The results have been least-squares fitted to a five-term series in powers of (300/T). Various correction factors to the harmonic approximation were considered in the calculation of the partition function ratios. It is demonstrated that the tabulated ratios can be used to calculate equilibrium constants for isotopic exchange reactions. (GE)

18273 PROCESS FOR THE RECOVERY OF DEUTERIUM FROM HYDROGEN-RICH GAS. Walter, S.; Schindewolf, U. (to Friedrich Uhde GmbH). US Patent 3,821,361. 28 Jun 1974. Filed date 30 Jun 1971. 6p.

A process is described for the recovery of deuterium from a gas having deuterium values and oxygen bearing impurities by contacting the gas with a solution of sodium or lithium in ammonia to eliminate oxygen-bearing impurities as sparingly soluble reaction products. The NH_3–Na or Li solution contacts the synthesis gas saturated with NH_3 having oxygen impurities and deuterium values therein and the deuterium rich ammonia gases from a deuterium enrichment unit in order to achieve saturation of higher deuterium concentration. The ammonia gases saturated with deuterium values are finally passed on to the deuterium enrichment unit to recover deuterium values and to produce ammonia depleted of deuterium. The preparation and/or stock tank for the Na or Li solution in NH_3 is provided with a lining material selected from the group consisting of copper, nonferrous metal, and plastics, because the NH_3–Na solution resides in these containers for an extended period of time. (Official Gazette)

18274 CATALYZED RADIOIODINE EXCHANGE. Hoey, G. B.; Peckels, D. R.; Wiegert, P. W. (to Mallinckrodt Chemical Works). US Patent 3,814,769. 4 Jun 1974. Filed date 1 May 1969. 6p.

Isotopic exchange between radioiodine atoms in an iodide salt and stable iodine atoms bound to aromatic carbon atoms is accelerated by the presence of catalytic amounts of copper, for example, by 2.3×10^{-4} mg of cupric sulfate per mg of organic compound. The presence of small amounts of water in the reaction medium further enhances the effect of copper. Not only is the conversion of stable iodinated compounds to their radioiodinated isomers substantially increased in many cases, but also lower temperatures and shorter reaction times are feasible with less risk of damage to heat-sensitive organic compounds thereby broadening the range of useful radioiodinated compounds which can be prepared by isotope exchange. Exemplified are quinolines, tryptophans, benzoic and iocetamic acids. (Official Gazette)

18275 SPECTROSCOPIC INVESTIGATION OF THE KINETICS OF HYDROGEN EXCHANGE BETWEEN AMINO AND SULFHYDRYL GROUPS IN THE GAS PHASE. Dimethylamine–methyl Mercaptan. Bureiko, S. F.; Denisov, G. S. (Scientific-Research Inst. of Physics, Leningrad). Kinet. Catal. (USSR) (Engl. Transl.); 14: No. 6, 1227-1230(1973).

Translated from Kinet. Katal.; 14: No. 6, 1384-1388(1973).

The exchange of hydrogen between dimethylamine and deuteromethyl mercaptan in the gas phase was studied using ir absorption methods. Values of the rate constant were obtained at temperatures in the range 10 to 80°C. The results were interpreted assuming a stepwise reaction mechanism: formation of a bimolecular complex with hydrogen bonding, and proton transfer within the complex during interaction with a third molecule. It was found that the value of the rate constant is determined by the same features of the electronic structure of the XH groups as control the ability of these groups to form hydrogen bonds. (auth)

18276 AQUEOUS HYDROXIDE ION. Pt. 1. Hydrogen Isotope Fractionation Studies by Proton Magnetic Resonance. Taylor, C. E.; Tomlinson, C. (Brighton Polytechnic, Eng.). J. Chem. Soc., Faraday Trans., I; 70: 1132-1139(1974).

The hydrogen isotope fractionation of the aqueous hydroxide ion has been studied through PMR measurements on lithium, sodium, and potassium hydroxide solutions in light and heavy water. The experimental results are analyzed in terms of the models OH^- and $H_aO^-(H_bOH_c)_3$ for the hydroxide ion. Only for the latter model is it possible to reconcile the data with literature data and only for certain ranges of values of the fractionation constants and chemical shifts of the protons involved. (auth)

18277 EXCHANGE OF DEUTERIUM WITH THE HYDROGEN OF THE SURFACE OF ZEOLITE CATALYSTS. I. Calcium Forms of Types X and Y Zeolites. Minachev, Kh. M.; Dmitriev, R. V.; Isakov, Ya. I.; Bronnikov, O. D. (Inst. of Organic Chemistry, Moscow). Bull. Acad. Sci., USSR, Div. Chem. Sci. (Engl. Transl.); 22: No. 12, 2625-2630(Dec 1973).

Translated from Izv. Akad. Nauk SSSR, Ser. Khim.; 22: No. 12, 2689-2696(Dec 1973).

The total concentrations of hydrogen (in the form of H_2O, OH, and H_3O^+) in CaX and CaY zeolites, evacuated at 10^{-4} torr and 300, 400, or 500°, were determined by the method of isotopic exchange with D_2. There is a threshold of degree of exchange of Na^+ for Ca^{2+}, after which a rapid increase in the content of protium and the catalytic activity of zeolites in reactions of the carbonium ion type is observed. The mobility of H, as well as its thermal stability, increase with increasing Ca^{2+} content and mole ratio SiO_2/Al_2O_3 in zeolites of the faujasite type. For calcium zeolites prepared from NaY, produced by hydrothermal synthesis and dealumination, the content and mobility of protium are close, which indicates identity of samples prepared by different methods. (auth)

18278 THE EFFECT OF ANHARMONIC VIBRATIONAL COUPLING ON DEUTERIUM ISOTOPE. Exchange Equilibria Involving Ring Dimers of Carboxylic Acids. Monse, E. U. Rutgers-the State Univ., Newark, N. J. (USA). Dept. of Chemistry). Z. Naturforsch., A; 28: No. 2, 174-176(Feb 1973).

1 tab.; 19 refs.

The observed isotope fractionation factor, α, for deuterium isotope exchange between liquid acetic acid and hydrogen gas is compared with a value of α calculated on the basis of a harmonic force field for the dimer. The calculated value of α is found to be about 30% higher than the observed value. The discrepancy is considered to be due to the neglect of anharmonic coupling between the hydroxyl bond stretching and the hydrogen bond stretching vibrations of the dimer. (auth)

18279 ISOTOPE FRACTIONATION OCCURRING IN THE OXYGEN CYCLE. Wagener, K. (Technische Hochschule Aachen (F. R. Germany). Lehrstuhl fuer Biophysik; Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Physikalische Chemie). Z. Naturforsch., A; 29: No. 2, 245-250(Feb 1974). (In German).

1 fig.; 1 tab.; 28 refs.

The present data on isotope fractionation factors involved in the oxygen cycle are reviewed. Physical models for the isotope fractionation of respiratory processes and photosynthesis on land are discussed. The consistency of all data is examined on the basis of a 2-box model (atmosphere and an ocean surface layer containing 90% of marine biomass). From this balance, the O_2 exchange rate between the two reservoirs results as $1/3$ of the marine production. This seems to be too low and therefore indicates that either one figure is bad, or the isotope exchange between CO_2 and O_2 is more important than expected. (auth)

Feed Materials Processing

Refer also to abstracts 18218 and 18909.

18280 (JEN-278) UF_4 PRODUCTION BY ELECTROLYTIC REDUCTION. Esteban Duque, A.; Gispert Benach, M.; Hernandez Arroyo, F.; Montes Ponce de Leon, M.; Rojas de Diego, J. L. (Junta de Energia Nuclear, Madrid (Spain). Div. de Materiales). 1974. 53p. (In Spanish). Dep. NTIS (US Sales Only) $5.75.

The electrolytic reduction of U(VI) to U(IV) was studied as part of the nuclear fuel cycle program developed at the Spanish Atomic Energy Commission. The effect of the materials, electrolyte concentration, pH, current density, cell size, and laboratory-scale production was studied. The pilot plant and the production data are also described. (auth)

18281 (MITG-270) URANIUM FROM LOW GRADE ORES, 1944-51. Final Report. Gaudin, A. M. (Massachusetts Inst. of Tech., Watertown (USA). Mineral Engineering Lab.). 28 Feb 1951. Contract AT(30-1)-Gen-211. 128p. Dep. NTIS $9.50.

Work performed during 1944 to 1951 on developing ore-treatment processes for extracting uranium from low-grade ores is reported. The processes and ores investigated included: continuous cold leaching of rejects from mill operations in the Congo; treatment of ores from Witwatersrand, South Africa which were originally mined for gold only; Lapointe sorting process for Canadian pitchblendes followed by leaching; extraction of uranium from US phosphate rocks used to produce ammonium phosphate; and treatment of various uranium ores from Western US. The processes found most promising were aqueous leaching (hydrometallurgical) processes, non-aqueous leaching (lyometallurgical) processes, and ion-exchange processes. Details of the research conducted on these processes are presented in the report appendices. (LCL)

Radiation Chemistry

Refer also to abstracts 18257, 18270, 18345, 18348, 18367, 18830, 18851, 19153, 19169, and 19424.

18282 (AED-Conf-74-084-008) RADICAL-INDUCED CLEVAGE OF THE GLYCOSIDE BONDING OF CELLOBIOSE IN AQUEOUS SOLUTION. von Sonntag, C.; Dizdaroglu, M. (Max-Planck-Institut fuer Kohlenforschung, Muelheim an der Ruhr (F. R. Germany). Abt. fuer Strahlenchemie). 1974. 2p. (In German). INIS.

From meeting of lecturers in chemistry; Stuttgart, F. R. Germany (31 Mar 1974).

1 fig.

The OH radicals and H atoms being formed (besides solvated electrons) in the γ-radiolysis of H_2O will extract C-bound H from cellobiose dissolved in H_2O. Among the radiolytic products, several sugars with $C <= 6$ can be found. The disproportionating reactions of the radicals are frequently preceded by H_2O cleavage and decarbonylating reactions. (GE)

18283 (ARH-2861) EFFECTS OF IRRADIATION ON COMBUSTION OF ORGANIC COMPOUNDS: A LITERATURE SURVEY. Barney, G. S. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). Feb 1974. Contract AT(45-1)-2130. 7p. Dep. NTIS $4.00.

Information found in the literature indicates that combustion efficiency and flame speed are increased when fuel-air mixtures are irradiated with very intense beta or gamma sources. In order to show any noticeable effect, however, radiation fields of at least 2000 Ci per cubic inch must be present. (10 references) (auth)

18284 (JAERI-M-5451) PRODUCTION OF POWDERY POLYETHYLENE FROM THE SLURRY OBTAINED IN THE WET-WALL TYPE RADIATION POLYMERIZATION PILOT PLANT. Sugo, T.; Takehisa, M.; Machi, S. (Japan Atomic Energy Research Inst., Tokyo). Nov 1973. 9p. (In Japanese). INIS.

In the wet-wall type radiation polymerization pilot plant producing polyethylene, the effect of method removing water and tert-butyl alcohol from the slurry on the specific surface area and morphology of the polyethylene has been studied. The following two are essential for obtaining the large specific surface area powder: (1) thorough removal of tert-butyl alcohol, followed by air drying of the polyethylene, (2) these two processes at temperatures lower than 100°C. The two methods were investigated: (1) tert-butyl alcohol is removed from the slurry by distillation at 85-98°C, then the polyethylene is filtered and air-dried; (2) tert-butyl alcohol is extracted with large amount of water in high speed agitation, then the polyethylene is filtered and air-dried. Both these methods give fine polyethylene powder, specific surface area 40-70 m^2/g and 60-100 m^2/g, respectively, much higher than the commercial polyethylene powders. (auth)

18285 (NP-20059) ENERGY TRANSFER BY EXCITATION IN γ-IRRADIATED N-ALKANE SINGLE CRYSTALS. I. Isotope Effect on Radical Formation as Studied by ESR. Gillbro, T.; Lund, A. (Forskningsraadens Lab., Studsvik (Sweden)). 1974. 19p. (LF-52). Dep. NTIS (US Sales Only) $4.00.

Single crystals of n-decane-d_{22} ($C_{10}D_{22}$) doped with $C_{10}H_{22}$ were γ-irradiated at 77°K. The radiation-induced alkyl radicals have been identified using electron spin resonance and the presence of two main species has been established. One radical is of the type

$-CD_2\dot{C}DCD_2-$, $\cdot C_{10}D_{21}$(II), and the other radical is of the type $CH_3\dot{C}HCH_2-$, $\cdot C_{10}H_{21}$(I). For $C_{10}D_{22}$ crystals with a small content of $C_{10}H_{22}$ the relative amount of the $\cdot C_{10}H_{21}$(I) type radicals was much higher than would be expected from simple stoichiometric considerations. Thus, in a crystal containing 0.25 mol % $C_{10}H_{22}$, 14% of the alkyl radicals were in the form of $\cdot C_{10}H_{21}$(I), according to estimates made by comparing observed spectra with simulated ESR spectra in which the two components were added in different relative amounts. Several mechanisms for the energy transfer in n-alkanes are discussed including ionic processes, hydrogen abstraction by hot hydrogen atoms and excitation transfer. The excitation model, however, offers by far the best explanation of the experimental results and it becomes possible to calculate the critical concentration of $C_{10}H_{22}$ for the most effective trapping process. The critical concentration is 0.2 mol %, which corresponds to a critical trapping distance of ca. 30 Å. (auth)

18286 (NP-20061) RELATIVE CONCENTRATIONS AND RELAXATION PROPERTIES OF ISOMERIC ALKYL RADICALS IN γ-IRRADIATED N-ALKANE SINGLE CRYSTALS. Gillbro, T.; Lund, A. (Forskningsraadens Lab., Studsvik (Sweden)). 1973. 19p. (LF-53). Dep. NTIS (US Sales Only) $4.00.

The relative concentrations of alkyl radicals $CH_3\dot{C}HCH_2R$(I) and $R'CH_2\dot{C}HCH_2R''$(II) were measured at low microwave power in some n-alkane single crystals γ-irradiated at 77°K to a dose of 1 Mrad. The relative concentration of radical (II) increased as the number of carbon atoms became larger. The amount of radical (I) was in agreement with a mechanism where all C–H bonds in a n-alkane molecule are ruptured with the same probability followed by an isomerization of primary alkyl radicals to radical (I). In n-decane for instance this mechanism predicts 45.5% of radical (I) compared to the experimental value of 42.5%. Saturation measurements of radical (I) and radical (II) under slow passage condition showed that the spin-lattice relaxation time T_1 is shorter for radical (I) (ca. 3×10^{-4}s) than for radical (II) (ca. 80×10^{-4}s), while the spin-spin relaxation times T_2 are similar (ca. 2×10^{-5}s). The relatively short relaxation time T_1 in radical (I) is thought to originate from higher mobility of the end of the alkane chain, where the unpaired electron is localized, combined with a modulation of the hyperfine coupling from the protons in the nearby rotating methyl group. The broad line width in irradiated protiated crystals was by comparison with results from deuterated matrices concluded to depend on slightly distorted radicals in damaged regions (spurs, short tracks, blobs) and not on electron dipole-dipole interactions. Unresolved γ proton couplings in radical (I) are thought to cause the spin-flip transitions at high microwave power. (auth)

18287 KINETICS OF THERMALLY-INDUCED CHARGE DECAY IN RUBBERS IRRADIATED AT 77°K. Bol'shakova, S. I.; Kuz'minskii, A. S. (Scientific-Research Inst. of the Rubber Industry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 8: No. 1, 51-56(1974).

Translated from Khim. Vys. Energ.; 8: No. 1, 61-67(1974).

A study was carried out of the thermally induced decay of trapped charges in a copolymer of butadiene with acrylonitrile and cis-polybutadiene irradiated at 77°K both with and without the additives phenyl-β-naphthylamine (PNA) and chloranil (CA). A "stepwise" charge recombination was observed. The recombination process depends on electron donor and acceptor additives. The decay of CA anion-radicals formally obeys a first-order kinetic law. Unlike the light-induced charge decay process, thermal treatment leads to a relatively large change in the total concentration of stabilized paramagnetic centers, approximately equal to the initial concentration of stabilized charges. The rates of charge decay and of chemical changes in the irradiated rubber were found to depend on the rate of thawing of the matrix. (auth)

18288 IDENTIFICATION OF SHORT-LIVED PRODUCTS FROM THE PULSE RADIOLYSIS OF HYDROCARBONS SATURATED WITH OXYGEN. Zimina, G. M.; Bakh, N. A. (Inst. of Electrochemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 8: No. 1, 46-50(1974).

Translated from Khim. Vys. Energ.; 8: No. 1, 56-60(1974).

The short-lived absorption spectra produced by the pulse radiolysis of oxygen-saturated hydrocarbons containing N_2O and I_2 scavengers have been investigated. From a comparison of these spectra with the radiolysis yields of final products from the oxidation of n-heptane it was found that individual gaussian components of the complex spectrum, band III (λ_{max}286 nm) and band IV (λ_{max}312 nm), are direct precursors of alcohols and carbonyl compounds, while the peroxy radical ($R\dot{O}_2$) (band I with λ_{max}270 nm) is a direct precursor only of peroxide compounds. Based on the identification of a short-lived absorption spectrum due to an α-alcohol radical in aqueous butanol solutions saturated with N_2O, band III was attributed to an alcohol precursor. (auth)

18289 OPTICAL ABSORPTION SPECTRA OF THE SOLVATED ELECTRON IN IRRADIATED ETHANOL AT ELEVATED TEMPERATURES. Marevtsev, V. S.; Vannikov, A. V.; Bakh, N. A. (Inst. of Electrochemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 8: No. 1, 42-45(1974).

Translated from Khim. Vys. Energ.; 8: No. 1, 52-55(1974).

The pulse radiolysis method was used to obtain the absorption spectrum of the solvated electron in ethanol at 22, 40, and 60°C. The spectrum has a resolved structure, the relative intensities of the separate bands being temperature dependent. The rate of decay of the optical absorption and the activation energy of this process are identical in the different regions of the spectrum within the limits of error of the measurements. The separate bands in the spectrum are explained by the presence of solvated electrons, differing according to the number of alcohol molecules in the solvation shell. (auth)

18290 RADIOLYSIS OF ADAMANTANE. Antonova, E. A.; Demina, N. G.; Pichuzhkin, V. I.; Saraeva, V. V. (Moscow State Univ.). High Energy Chem. (USSR) (Engl. Transl.); 8: No. 1, 39-41(1974).

Translated from Khim. Vys. Energ.; 8: No. 1, 49-51(1974).

Investigation of the effect of temperature in the range –196 to 240°C showed that the radiation yield of hydrogen depends on the form of the crystalline lattice. Below 65°C the effective activation energy for H_2 formation is 0.05 ± 0.05 kcal/mole, compared with 0.9 ± 0.45 kcal/mole at higher temperatures. A reduction in the hydrogen yield above 160°C is associated with the start of radiation-thermal cracking and the formation of C–C bond rupture products. Among the heavy products compounds were observed containing two, four, and higher numbers of adamantane structures. (auth)

18291 RADIATION–CHEMICAL DECARBONYLATION OF ACETALDEHYDE IN AQUEOUS AND ALCOHOLIC SOLUTIONS. Shadyro, O. I.; Kalyazin, E. P.; Petrysev, E. P. (Belorussian State Univ., Minsk). High Energy Chem. (USSR) (Engl. Transl.); 8: No. 1, 69-70(1974).

Translated from Khim. Vys. Energ.; 8: No. 1, 82-83(1974).

Results are presented which show that the decarbonylation rate is greatly changed on passing from water to methanol as the solvent. Irradiations were carried out on oxygen-free 1 M solutions of acetaldehyde in methanol, water, and a 1:1 mixture of these, using an LMB-γ-1M γ source. The dose rate determined by the ferrous sulfate method was 60 rad/sec. The gaseous radiolysis products were analyzed by gas chromatography on a KhL-6 chromatograph, using a 3-m column of KSM silica gel and helium carrier gas. The yields of CO and CH_4 are given. (LK)

18292 DETERMINATION OF THE UPPER LIMIT OF STORED ENERGY IN γ-IRRADIATED POLYETHYLENE. Briskman, B. A. (Inst. of Physical Chemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 8: No. 1, 67-68(1974).

Translated from Khim. Vys. Energ.; 8: No. 1, 80-81(1974).

Calculations of the stored energy in γ-irradiated polyethylene were made and published earlier. They were based on calorimetric measurements and varied from 2 to 3.7% of the absorbed γ energy. The values of this upper limit are naturally very dependent on the accuracy of the measurements. This determination differs from the previous ones mainly by the higher accuracy of the measurements. (LK)

18293 PULSE RADIOLYSIS OF ALKALI HALIDES. Makarov, I. E.; Zhukova, T. N.; Pikaev, A. K. (Inst. of Physical Chemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 8: No. 1, 62-66(1974).

Translated from Khim. Vys. Energ.; 8: No. 1, 74-79(1974).

Pulse radiolysis and low-temperature spectroscopy were used to investigate the primary radiation-chemical processes in single crystals of alkali halides (AH). The optical characteristics of electron and hole centers were determined, and measurements carried out of their initial yields (at the end of a pulse) and the yields of stable F-centers. The primary hole centers disappear not in reactions with F-centers, but by aggregation and stabilization on impurities and structural defects. The partial decay of F-centers in crystals with a NaCl-type lattice is determined by their reaction with more stable hole centers. The F-center yield falls by two orders of magnitude on reducing the temperature from 300 to 77°K. The total radiation-chemical decomposition yield decreases in the series LiF, NaCl, KCl, KBr, CsI, apparently owing to an increase in the importance of back reactions involving electron and "hole" centers. (auth)

18294 ROLE OF SOLVATED ELECTRONS IN THE PULSE AND CONTINUOUS RADIOLYSIS OF THE HYDRAZINE–WATER SYSTEM. Slavinskaya, N. A.; Kozlov, B. M.; Petrukhin, N. V.;

Kamenetskaya, S. A.; Pshezhetskii, S. Ya. (Inst. of Physical Chemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 8: No. 1, 57-61(1974).

Translated from Khim. Vys. Energ.; 8: No. 1, 68-73(1974).

The pulse radiolysis method was used to investigate the optical and kinetic properties of solvated electrons in aqueous hydrazine solutions. The absorption band maximum was found to shift with changes in the solution concentration. The kinetics of the disappearance of optically active species was studied in solutions containing N_2H_4 from 10 to 90 vol. % and from 10^{-4} to 3M, at temperatures from -40 to +35°C, and at various dose rates. The rate constant for the decay of solvated electrons increases with increasing dose rate. The pulse radiolysis of hydrazine in the presence of electron and hydrogen atom scavengers was compared with the radiolysis of these systems using continuous γ-radiation; this showed that the composition of radiolysis products depends on electron capture by the scavenger. (auth)

18295 STABILITY OF METHYL-SUBSTITUTED POLYSTYRENES TO β IRRADIATION. Gunder, O. A.; Kobs, V. S. (All-Union Scientific-Research Inst. for Single Crystals, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 8: No. 1, 71-72(1974).

Translated from Khim. Vys. Energ.; 8: No. 1, 83-84(1974).

Radiation stability of styrene, vinyltoluene, and vinylxylene polymers was studied. Radiation-induced changes in the polymers were determined from changes in the luminescence spectra, from the rise in intensity of the absorption band due to the carbonyl group in IR spectrum, and also from the change in solubility of the polymer and the appearance of a gel fraction. Polystyrene had the highest radiation stability. The radiation stability of polyvinyltoluene depends on the position of the methyl group in the benzene ring; the least stable is the polymer based on p-vinyltoluene. (LK)

18296 ESR SPECTRA OF GAMMA-IRRADIATED OXYSTARCH. Nozawa, Y.; Suzuki, M.; Higashide, F. (Shizuoka Coll. of Pharmacy, Japan). Nippon Kagaku Kaishi; 1973: No. 11, 2043-2047(Nov 1973). (In Japanese).

ESR spectra of γ-irradiated starch, starch formate, glucose, sodium alginate, D-glucuronic acid, oxystarch and oxycellulose have been determined at room temperature. Characteristic spectrum of a doublet was obtained in case of starch, and of a singlet in sodium alginate. The spectra of oxystarch and oxycellulose were similar to each other and complicated. Upon heating the irradiated oxycarbohydrates at 100°C for 60 min the spectrum changed to a broad singlet which may be considered to consist of two singlets having slightly different g-factors. The component of the esr signal that had disappeared on heating was similar to the doublet spectrum observed for the irradiated starch. The chemical structure of the radicals produced in the irradiated systems was discussed referring also to the result of irradiated compounds of oxystarch-ures and of oxystarch-polyvinylalcohol. (auth)

18297 ULTRAVIOLET AND X-RAY INDUCED RECOMBINATION LUMINESCENCE OF L-TRYPTOPHAN IN LOW TEMPERATURE POLAR MATRICES. Moan, J. (Norsk Hydro's Inst. for Cancer Research, Oslo). J. Chem. Phys.; 60: No. 10, 3859-3865(15 May 1974).

The long-lived isothermal luminescence and thermoluminescence of L-tryptophan in 9M LiCl and in ethylene glycol/water (EG/H_2O) glass irradiated with uv light and x rays were investigated. The spectra of the luminescence as well as the effect of an electron scavenger indicate that it arises from electron-cation recombination. In EG/H_2O the decay kinetics of the long-lived isothermal phosphorescence and the shape of the thermoluminescence glow curve as well as the isothermal luminescence/thermoluminescence ratio are identical for the two types of irradiation. Hence it is concluded that the distribution of electron-cation distances is the same in the two cases for the ion pairs that give rise to recombination luminescence. In LiCl/H_2O glass the decay kinetics of the long-lived luminescence is the same after x-ray and uv irradiation, but the glow curves are different. This difference may be explained by the following observations: (a) x rays induce radicals and long-lived luminescence in the pure solvent; (b) in an x-irradiated LiCl/H_2O glass the absorption spectra indicate that tryptophan molecules react with radicals of the solvent at about 140°K to produce tryptophan cations. Luminescence may be emitted in the reaction of these tryptophan cations with trapped electrons or anions. In EG/H_2O the uv-induced recombination luminescence is pure phosphorescence of tryptophan while in LiCl/H_2O fluorescence is also seen at temperatures below 130°K. This is interpreted in terms of the trapping energy of the recombining ion pairs. The fraction of the recombinations that give rise to molecules in the triplet state has been estimated from the luminescence spectra. (auth)

18298 MAGNETIC RESONANCE STUDIES OF THE ANTIFERROELECTRIC PHASE TRANSITION IN THE AMMONIUM ARSENATES $NH_4H_2AsO_4$ AND $ND_4D_2AsO_4$. Dalal, N. S.; McDowell, C. A.; Srinvasan, R. (Univ. of British Columbia, Vancouver). J. Chem. Phys.; 60: No. 10, 3787-3794(15 May 1974).

The antiferroelectric phase transitions in $NH_4H_2AsO_4$ and $ND_4D_2AsO_4$ were studied through EPR and NMR. The paramagnetic center AsO_4^{4-}, created by x irradiation of these compounds, was used as a microscopic probe in the EPR studies. Both ^{75}As hyperfine structure and the superhyperfine structure from the hydrogen-bond protons showed changes on passing through the Curie point. Some features of the EPR spectra were identified with the configurations postulated by Nagamiya in his model of the phase transition in these antiferroelectrics. In conjunction with earlier Raman scattering, Moessbauer effect, NMR, and dielectric studies of ADP, the present EPR studies point to a model of the phase transition where the NH_4^+ ions play a dominant role. At high temperatures, well above the Curie point (T_c), the NH_4^+ ions are thought to be executing fast reorientations such that they behave effectively like the spherical ions K^+, Rb^+, or Cs^+. At T_c there is sudden change in the motion of the NH_4^+ ion and each NH_4^+ ion is thought to make a permanent hydrogen bond with an oxygen of an AsO_4 group, leading to a distortion of the group and hence a phase transition. Measurements of the proton nuclear spin-lattice relaxation times (T_1) support this model. Comparison and earlier results on $NH_4H_4PO_4$-(ADP) suggests that the same mechanism is operative in the phase transition of ADP also. Several anomalies mentioned in earlier studies on KH_2PO_4-type compounds could also be rationalized on the basis of the present model. Implications of the present work to the Nagamiya model and further experiments to check the conclusions of the present work are also pointed out. (auth)

18299 PHYSICO-CHEMICAL CHANGES OF CIS- AND TRANS-EPHEDRINE UNDER THE EFFECTS OF γ RADIATION. Ibragimov, Kh. P.; Rustamov, Kh. R.; Abrarov, O. A. (Tashkent Polytechnical Inst.). Uzb. Khim. Zh.; No. 2, 23-24(1974). (In Russian).

The effect of γ radiation on the physico-chemical properties of the cis-trans isomers of ephedrine was studied. The solubility in various solvents, specific rotation, and their mutual conversion were studied. The absorption spectra of the isomers were determined before and after irradiation. (tr-auth)

18300 EFFECT OF TEMPERATURE ON THE RATE OF THE RADIOLYTIC DEUTERIUM-HYDROGEN EXCHANGE IN THE GAS PHASE. Kulazhenkova, N. A.; Larin, I. K.; Tal'roze, V. L. (Inst. of Chemical Physics, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 8: No. 1, 76-77(1974).

Translated from Khim. Vys. Energ.; 8: No. 1, 87-88(1974).

Experiments were carried out on the γ-radiolysis of equimolar deuterium-hydrogen mixtures at various temperatures. It was found that the rate of the radiolytic exchange falls by a factor 1.6×10^3 on decreasing the temperature from 290 to 77°K. (LK)

18301 ELECTRON BEAM CURING OF COATINGS. Effects of Irradiation Conditions and Inert Gas. Suzuki, Y.; Shibayama, K. (Mitsubishi Electric Corp., Amagasaki, Japan). Mitsubishi Denki Giho; 47: No. 2, 193-197(Feb 1973). (In Japanese).

Radiation sensitive paints are cured by radical polymerization mechanism, and effects of irradiation conditions and atmosphere become important. Effects on the viscoelastic properties of the cured films of modified acrylic polymers are described, which are produced by electron beam irradiation at different total dose or dose rate, and in multiple passes. The irradiation conditions are (1) the dose rate (DR) constant with varied total dose (TD) and (2) vice versa, and (3) multiple passes. For the condition (1), cross-linking increases with TD, converging to the same value. For (2), it decreases with DR, leading to the same effect as small dose. In (3), there is not much benefit of the multiple passes. The effect of the dose rate has close relation with the viscoelastic properties of films. The curing dose is greatly reduced in inert gas (such as nitrogen) atmosphere, improving considerably surface hardness. (JA)

18302 ESTIMATION OF PRODUCTION COSTS OF CHEMICALS PRODUCED IN NUCLEAR REACTORS. Borisov, E. A.; Timofeev, V. D. Sov. J. At. Energy (Engl. Transl.); 33: No. 5, 1062-1063(Nov 1972).

Translated from At. Energ. (USSR); 33: No. 5, 916(Nov 1972). This is a summary of paper No. 621/6692 with full copy held at TIC.

Chemical processes utilizing the radiation from nuclear fuel will be possible in principle in the not-too-distant future. This radiation constitutes a cheap form of energy. If the cost of power derived from isotope sources of radiation is 1 dollar per kWh, then the use of mixed radiations from a nuclear reactor can cut that

cost down to 0.1 dollar per kWh, and the cost can be lowered still further to 0.001 dollar per kWh, by using the fission fragments of fissionable material. From that standpoint, prospects for engineering chemical processes involving the practical use of nuclear reactors appear highly promising. A procedure for making cost estimates of the outlook for radiation-chemical synthesis processes involving the use of a nuclear reactor as the source of radiations has been worked out on the basis of tentative laboratory data. The following structure of costs governing net production costs when a nuclear reactor is used has been accepted: raw materials and processed materials (including auxiliary materials), nuclear fuel costs (fuel component), power costs, amortization writeoff, department costs (including building erection and upkeep costs, costs of structures and equipment, personnel wages, etc.), total-plant costs, income from side products (including power generated by the nuclear reactor). (auth)

18303 MICRO-DETERMINATION TECHNIQUES FOR HYDROGEN PEROXIDE IN IRRADIATED SOLUTIONS. Gupta, B. L. (Bhabha Atomic Research Centre, Trombay, India). Microchem. J.; 18: No. 4, 363-374(1973).

Optimum conditions were established for determining H_2O_2 by (i) causing it to oxidize Fe^{2+} in the presence of xylenol orange and spectrophotometry (at 540 nm) of the resulting Fe^{3+}-xylenol orange complex and (ii) spectrophotometry (at 520 nm) of the Ti–xylenol orange–H_2O_2 complex. For the first method, the optimum medium is 0.05N H_2SO_4, the ϵ value is 26,800 and the extinction is rectilinearly related to H_2O_2 concentration between 10 and 40 μM; Ti and chelating agents interfere but F^- do not, and addition of NaCl prevents interference from organic compounds. For the second method, 0.03 N H_2SO_4 is the optimum medium, the ϵ value is 7400 and the relationship between extinction and concentration is nearly rectilinear for 0.1 to 0.4 mM-H_2O_2. (Anal. Abstr.)

18304 ELECTRON SPIN RESONANCE STUDY OF THE $[MoO_4]^{7-}$ RADICAL IN A γ-IRRADIATED AMMONIUM MOLYBDATE SINGLE CRYSTAL. Wang, H.; Yang, Y.; Ch'en, Y. (Lanchow Inst. of Chemical Physics, China). Sci. Sinica (Peking); 17: No. 1, 17-25(Feb 1974).

An ESR technique was employed to study the mechanism of formation and the structure of the $[MoO_4]^{7-}$ ion-radical in a room-temperature γ-irradiated ammonium molybdate single crystal. The result showed the valence state of the molybdenum atom was reduced from six to five during the course of the radiative chemical reaction. Analysis of the spectra of the deuteriated specimen indicated that the superhyperfine structure arose from the interaction of the unpaired electron of molybdenum atom with its nearest proton neighbor. The lowering of the orbital moment suggested that the magnetic electron in the 4d orbital of the molybdenum atom transfers part of its electron cloud to its ligand. (JPRS)

18305 MECHANISM OF FORMATION AND SOME SURFACE CHARACTERISTICS OF THIN POLYMER FILMS FORMED ON METAL SURFACES BY ELECTRON BOMBARDMENT. Frost, S.; Murphy, W. J.; Roberts, M. W.; Ross, J. R. H.; Wood, J. H. (Bradford Univ., Eng.). Faraday Spec. Discuss. Chem. Soc.; No. 2, 198-209(1972).

From solid/solid interfaces; Nottingham, Eng. (18 Sep 1972).

The formation of thin films by electron bombardment has been studied and some of the important factors controlling the nature and surface characteristics of the films have been identified. A number of experimental techniques have been developed in order to obtain information on both the species likely to be involved in film growth and also the nature of the film surfaces. The surface characteristics have been monitored by contact angle studies. The possible importance of negative ions in film formation is illustrated with $Si(CH_3)_4$, where over 20 different negative ions were detected, the major ones being H^-, C_2H^- and SiC_2^-. Such results also have an important bearing on electron affinity data obtained by the magnetron method. Thin films formed from perfluorobut-2-ene have surface characteristics which vary with the monomer pressure, the substrate temperature, and electron and ion energies. Information on the relative importance of the role of negative ions compared with electron and adsorbed monomer reaction is obtained. Some suggestions are discussed regarding possible surface structures inferred from wetting characteristics. (auth)

18306 STUDY OF THE LOW-TEMPERATURE PHOTOCONVERSION IN γ-IRRADIATED MONOCRYSTALS OF GLYCINE BY THE EPR METHOD. Shul'ga, S. Z.; Dem'yanchuk, A. P. Zh. Prikl. Spektrosk.; 20: No. 5, 876-880(May 1974). (In Russian).

The effect of light on the centers of radiation damage in glycine monocrystals was studied at low temperatures. Comparison of the results obtained by the EPR method on ordinary samples and samples deutero-substituted by polar groups showed that the change (reversal) of the EPR spectrum of the protonated γ-irradiated crystal is connected with the presence of intermolecular photo-stimulated transfer of free valences. (tr auth)

18307 EFFECT OF γ IRRADIATION AND IMPURITIES ON THE POSITION OF THE INTRINSIC ABSORPTION EDGE OF SOLUTIONS OF TRIGLYCINE SULFATE CRYSTALS. Gulish, O. K.; Leonidova, G. G.; Netesova, N. P. Zh. Prikl. Spektrosk.; 20: No. 5, 918-920(May 1974). (In Russian).

The position of the intrinsic absorption edge and the change of the width of the forbidden zone were studied as a function of γ irradiation and the quantity and nature of the impurities introduced into the crystalline structure of the triglycine sulfate in solution in unipolar crystals. The intrinsic absorption edge of the solution of selected crystals is displaced to the longer wave lengths with increase of the degree of irradiation, and the width of the forbidden zone is decreased. The introduction of impurities has practically no effect on the width of the forbidden zone. (tr-auth)

18308 DYNAMICS OF THE OPTICAL INHOMOGENEITIES AND THE INDUCED EXTINCTION DURING ELECTRON IRRADIATION OF ORGANIC SOLVENTS. Dolgov-Savel'ev, G. G.; Knyazev, B. A.; Fokin, E. P. Zh. Prikl. Spektrosk. 20: No. 5, 805-809(May 1974). (In Russian).

The dynamics of the optical distortion and intensity extinction of the laser beam passing through organic solvents (acetone and toluol) during irradiation with a pulsed beam of fast electrons (U_e = 0.9 MeV) was studied by means of a pulsed rhodamine B laser. It was shown that as a result of the inhomogeneous dissipation of energy in the liquid an effective prism, deflecting the laser beam 40', is formed. It was shown that at the moment of current pulsation strong extinction appears (decaying after pulses with a constant time $\tau_1 = 1.3 \pm 0.6$ in acetone and 3.7 ± 1.1 μsec in toluol which then weakens ($\tau_2 \sim 100$ μsec). The mechanisms responsible for the appearance of different forms of loss were discussed. (tr-auth)

18309 POLYETHYLENE FOAM. Sagane, N.; Nakada, S. (Sekisui Chemical Co. Ltd., Osaka). Kogyo Zairyo; 21: No. 9, 40-44(Sep 1973). (In Japanese).

An aspect of the unique industrial application of radiation chemistry is described on the method of making polyethylene foam by the cross-linking owing to radiation under atmospheric pressure. The technique of making polyethylene foam in Japan has so advanced in quality and quantity that license has been granted to the industries in foreign countries. The processes employed in Toray Co. and Sekisui Kagaku Co., both in Japan, and Voltek Co. in the United States, are introduced in this paper. The processes include the steps of extruding the mixture of polyethylene and foaming powder into a sheet, irradiating thus formed sheet to cross-link, and continuously expanding the sheet to foam by heating with a special foaming apparatus. In the control of radiation cross-linking, adequate gel content is generally 20 to 40%. The required radiation dose is 1 to 5 Mrad. The size of product in this radiation process can be from two to four times as large as the limitation in chemical cross-linking process. In the irradiation step, capacity of one line comprising one accelerator is large and exceeds 100 tons per month of the polyethylene foam. It is desirable to use the accelerator being capable of continuous irradiation and with high reliability. The typical foaming apparatuses are vertical suspension system and liquid floating system. The properties and use of the polyethylene foam are described. Its development is very promising. (JA)

18310 PROCESS FOR THE PRODUCTION OF SYNTHETIC FILAMENTS AND PLANAR BODIES. Barthel, R.; Zilinski, E.; Reichert, H.; Schon, W. (to VEB Chemiefaserkombinat Schwarza). British Patent 1,348,911. 27 Mar 1974. 7p.

In the process described one or more polymerizable substances, which may be admixed with one or more cross-linkable substances, is wholly or partially polymerized and optionally cross-linked by electron irradiation in a suitable former. The electron beam energy should be in the range 0.3 to 1.5 MeV. The polymerizable substance may be acrylamide. A viscosity-increasing substance may be added to the polymerizable substance; this may be an oligomer of methyl methacrylate. The process may be made continuous. A peroxide initiator or photochemical initiator may be used in conjunction with the electron radiation. Suitable former constructions are described. A number of examples of application of the process are given. (UK)

18311 SPECTRA AND DECAY OF TRICHLOROMETHYL RADICALS IN AQUEOUS SOLUTION. Lesigne, B.; Gilles, L.; Woods, R. J. (CEN de Saclay, Gif-sur-Yvette, France). Can. J. Chem.; 52: No. 7, 1135-1139(1 Apr 1972).

Trichloromethyl radicals are formed by the pulse radiolysis of aqueous carbon tetrachloride solutions. At concentrations

of the order of 10^{-4} M and pH 5.5–12.4, CCl_3^- disappears by a second-order process with $2k = (7.4 \pm 1.8) \times 10^8$ M^{-1} s^{-1} and without detectable hydrolysis. Both CCl_3^- and $CHCl_2$ are believed to be formed by the pulse radiolysis of aqueous chloroform solutions but at wavelengths greater than 230 nm only absorption attributable to CCl_3^- was observed. (auth)

18312 PHOTORADIATION PROCESSES. pp 373-406 of EPR Svobodnykh Radikalov v Radiatsionnoi Khimii. Pshezhetskii, S. Ya. (ed.). Moscow; Khimiya (1972). (In Russian).

Results are presented on EPR studies of photochemical conversions of free radicals in irradiated substances: the radicals NH_2^-, NF_2^-, and $N(CH_3)_2^-$, alkyl radicals, allyl radicals, polyene radicals, acyl radicals, alcohol and ether radicals, alkyl amine radicals, peroxy radicals, sulfur-containing radicals, and polymer radicals. From a study of the photochemical conversions of the radicals it is possible to draw the following conclusions. Radicals under the action of light are converted to an electronic-excited state. In this case the excited radicals can enter into reactions that in the non-excited state do not occur (or proceed slowly). The excited radical state can be characterized by a different distribution of electron density than in the ground state, as a result of which the reactions of radicals in the excited state can be different than the reaction of radicals in the ground state. The presence of free radicals widens the region of optical density of a substance, that is, it increases the light sensitivity of a substance. Free radicals can be considered as sensitizers which can substantially increase the efficiency of breaking down a basic material under the action of light. (SJR)

18313 WASTE-WATER TREATMENT BY IRRADIATION. Sunada, T. (Radiation Center of Osaka Prefecture, Sakai, Japan). Genshiryoku Kogyo; 19: No. 10, 33-36(Oct 1973). (In Japanese).

A review was made on the nature of waste water as an object of irradiation, the effects of irradiation, toxicity of treated products, economy of irradiation treatment, and the safety of radiation treatment of waste water. Estimated effects of irradiation of waste water are the destruction of pollution substances in the waste water, killing of microorganisms, and coagulation of colloids suspended particulates caused by the neutralization of electric charges. The most important is the destruction of chemical pollution substances by irradiation. Destruction or decomposition of chemical substances by irradiation is more effective than the decomposition by chlorine, hydrogen peroxide, and ozone. For example, PCB and methyl mercury chloride, which are hardly decomposed by other methods, are decomposed by irradiation. The number of decomposable materials or chemical species is especially large in the treatment with irradiation, whereas only a small number of chemical substances are decomposed by various agents. Treatment of waste water with ozone often produces various poisonous ozonides, but the treatment by irradiation is seldom accompanied by secondary toxicity. The cost of irradiation treatment is rapidly decreasing year by year. Therefore, the irradiation with, for example, ^{60}Co will be used more often in the future. Radiation shielding for safety is the most important problem in the application of irradiation to waste-water treatment. (JA)

18314 FLUORESCENCE QUENCHING OF UV AND γ EXCITED AROMATIC SOLUTIONS BY CHLOROFORM AND SEVERAL RELATED CHLORINATED METHANES. Saperstein, D. D. New York; New York Univ. (1973). 207p. University Microfilms Order No. 74-13,370.

Thesis (Ph. D.).

The purpose of this study was to resolve certain questions concerning the unusual ability of $CHCl_3$ to quench upper excited states of benzene (excited by γ rays), and if possible, to present a scheme for understanding the quenching process in general. The systems studied consisted of a series of methylbenzene solvents (benzene, toluene, o-xylene, p-xylene and anisole) and a series of chloromethane (Q) quenchers (CCl_4, $CFCl_3$, CH_2-CCl_3, $CHCl_3$, $CDCl_3$, and CH_2Cl_2) in concentrations ranging from 10^{-3} M to 0.6 M. These systems were excited by uv (up to 6.7 eV) and some cases, by γ rays. The quenching process for all initial states of electronic excitation of the host was visualized as proceeding through the formation of a DA exciplex between the host and quencher as: $S^n + Q^0 \underset{k_r}{\overset{\gamma_{nh}}{\rightleftharpoons}} (S \cdots Q)^* \xrightarrow{k_f}$ products, where γ_{nh} represents a diffusion controlled process, k_r represents a nonreactive scattering out of the DA state $(S \cdots Q)^*$ and k_f represents the forward process of quenching. The overall measured quenching rate constant γ_{nhq} was taken to be $\gamma_{nh} \cdot k_f/(k_f + k_r)$. Using a simple geometry for the intermediate product DA exciplex, the energy of the DA state was estimated and from this value, it was possible to obtain values of k_f for the cases S^1 and S^3. k_r was assumed to be larger than k_f, and this assumption was shown to be reasonable; in addition, it was shown that γ_{nh}/k_r should be relatively constant. The measured rate constant γ_{nhq} was thus taken to vary as k_f varied. It was shown that for S^1 excitation, the DA state lay above that of S^1 or Q* and that the observed relative quenching efficiencies of the chloromethanes could be rationalized by proposing that the quenching process proceeded by a tunneling between the initial (S^1Q^0) state and the final (S^0Q^*) state. The relative rate constants k_f were estimated and shown to agree qualitatively with the measured S^1 quenching rates of the chloromethanes, with the exception of CH_2Cl_2. The fluorescence quenching of an S^n methylbenzene (S^2 and S^3) by the chloromethanes was also measured, and the relative efficiencies of the host-quencher system were rationalized with the same concepts used to explain S^1 quenching. However, the vibrational overlap, Franck–Condon factor, is seen to play a dominant role in the case of quenching S^n $(n > 1)$. Thus, the relative magnitude of the quenching in the host-quencher systems is characterized by only the relative Franck–Condon factors for the transitions: $S^nQ^0 \rightarrow DA$ and $S^nQ^0 \rightarrow S^1Q^0$. This study has assumed that the quenching of an upper excited state S^n is essentially a diffusion controlled process. The suitability of the Stern–Volmer treatment for the data is consistent with this assumption. However, there is another mechanism proposed by Ware and Lewis that can also be cast into a Stern–Volmer form which is not based upon diffusion. The Ware and Lewis proposal is that a ground state complex between host and quencher $(SQ)^0$ can form, and that $(SQ)^0$ absorbs light in competition with S^0, producing an apparent S^n fluorescence quenching; the excited (SQ) dissociates radiationlessly. At present there is insufficient evidence to characterize the S^n fluorescence quenching as being due either to diffusional energy transfer or to ground state complex formation. (Diss. Abstr. Int., B)

18315 RADIATION PROCESS OF PREPARING GRAFTED ELASTOMERIC FIBERS WHEREIN POST–DECRYSTALLIZATION IS EMPLOYED. Williams, J. L.; Stannett, V. T. (to J. P. Stevens and Co., Inc.). US Patent 3,814,676. 4 Jun 1974. Filed date 7 Oct 1971. 6p.

Cellulose-containing fibrous materials such as rayon yarn are converted into elastic materials by a process in which the fibrous materials are irradiated, an acrylate monomer is graft copolymerized onto the irradiated material and the product of the grafting process is treated with a decrystallizing agent. The elastic product obtained possesses good extensibility and elastic recovery and can be used in place of fibrous rubber in the preparation of elastic products. (Official Gazette)

18316 I. SEMICONTINUUM MODEL FOR SOLVATED AND TRAPPED ELECTRONS IN POLAR LIQUIDS AND SOLIDS. II. Electron-Electron Double Resonance Study of Trapped Electrons in Alkaline Ice and 2-Methyltetrahydrofuran. Feng, D. F. Detroit; Wayne State Univ. (1973). 364p. University Microfilms Order No. 74-11,097.

Thesis (Ph. D.).

A semicontinuum model is developed for solvated and trapped electrons in polar liquids, liquid ammonia (203°K), water (298°K), methanol (298°K) and ethanol (298°K), and solids at 77°K such as the alcohols, MTHF, and three aliphatic amines. Both short-range charge-dipole and long-range polarization interactions between the electron and the solvent molecules are calculated self-consistently. The configurational stability for the ground state has been established by applying the variational procedure to the total energy of the system. This allows the prediction of a unique cavity radius within the framework of the approximations used. Configuration coordinate diagrams are presented for the above matrices. Physical properties of the electrons are calculated and discussed from the viewpoint of matrix polarity. The calculated results are generally in semiquantitative agreement with experimental values. Electron-electron double resonance (ELDOR) has been used to test the validity of the noninteracting spin packet model for inhomogeneously broadened electron paramagnetic resonance (EPR) lines as applied to trapped electrons in 10 M NaOH ice. Spectra simulation of field-swept ELDOR spectra based on the spin-packet model qualitatively, but not quantitatively, accounts for the observed spectra. The quantitative failure of the spin packet model is interpreted in terms of spin diffusion within the EPR line. Structure in frequency-swept ELDOR spectra, which is not predicted by the spin packet model, has been observed and interpreted as ~5.7 G hyperfine coupling with eight matrix protons. This supports a tetrahedral model of oriented water dipoles for the immediate environment of the trapped electron in alkaline ice. Electron-electron double resonance (ELDOR) of trapped electrons and radicals in γ-irradiated MTHF glass at 77°K was investigated. Magnetic energy pumped into the radical spin system is transferred to the trapped electron spin system to partially saturate it. The cross saturation mechanism is consistent with dipolar cross-relaxation in which a radical spin flips down and an electron spin flips up. Analysis of the rate of spin relaxation shows that the reciprocal ELDOR reduction is linear with pumping microwave power with an

intercept which gives the ratio of the cross-relaxation time to the electron spin-lattice relaxation time. The experimental data are found to fit this relationship. This ratio of relaxation times is of the order of 0.5 while the relaxation times themselves are in the 10^{-4} sec range. The observation of cross-relaxation in this system supports the concept that the trapped electron and radical are spatially correlated in γ-irradiated MTHF. (Diss. Abstr. Int., B)

18317 PROCESS OF POLYMERIZATION. Battaerd, H. A. J.; Clouston, G. J.; Moore, P. W. US Patent 3,814,677. Jun 1974. Priority date 28 Sep 1971, Australia. 8p.

A method of polymerizing a mixture containing from 3 to 100% of compounds containing two or more allyl groups is described. The method comprises exposing said mixture to high-energy irradiation at a temperature in the range from −80 to+120°C, preferably from 10 to 90°C and at a pressure in the range from 1,000 to 100,000 psi and isolating the polymer salt so formed. The polymer product has improved ion-exchange properties. (Official Gazette)

18318 NUCLEAR MAGNETIC RESONANCE STUDY OF POLY(OXYMETHYLENE). Hikichi, K.; Tsutsumi, A.; Oda, J. I.; Kaneko, M. (Hokkaido Univ., Sapporo). Polym. J.; 6: No. 1, 56-60(Mar 1974).

NMR measurements were carried out for poly(oxymethylene) samples which were subjected to various kinds of treatment such as annealing, rolling, and γ-irradiation. It was found that the narrow component narrows in two steps and that the line narrowing which appeared at higher temperatures is markedly influenced by sample treatment. The second moment of amorphous regions at liquid-nitrogen temperature, $\langle \Delta H^2 \rangle_a$, was estimated. The result indicates that the amorphous region of the quenched sample is heterogeneous. Annealing was found to transform the morphology to the more nearly ideal two-phase structure. The decrease of the second moment between −197 and 20°C is due to molecular motion in the crystalline region as well as the lattice expansion. (auth)

18319 FORMATION OF ISOMERIC SUGARS DURING IRRADIATION OF FROZEN AQUEOUS SOLUTIONS OF HEXOSES. Kochetkov, N. K.; Kudryashov, L. I.; Senchenkova, T. M.; Danilov, V. L. (Inst. of Organic Chemistry, Moscow). Dokl. Chem.; 213: No. 1-3, 839-840(Nov 1973).

Translated from Dokl. Akad. Nauk SSSR; 213: No. 1, 95-97 (Nov 1973).

Polycrystalline frozen argon-saturated 10^{-2} M solutions of glucose, galactose, and mannose were irradiated with a dose of $2.5-3 \times 10^{21}$ eV/ml · sec at −78°C. After irradiation, the solutions were lyophilized, and fractions enriched in radiolysis products were separated by chromatography. Study of the enriched fractions revealed that irradiation of all three hexoses resulted in isomerization of the original hexoses via inversion of configuration at carbon atoms. (LK)

18320 KINETICS OF INITIATED OXIDATION OF SUBSTITUTED PHENOLS IN WATER. Kirso, U.; Uibopuu, Kh.; Tuulmets, A.; Gubergrits, M.; Lille, Yu. (Inst. of Chemistry, Tallin). Reakts. Sposobnost Org. Soedin., Tartu. Gos. Univ.; 10: No. 3, 625-636(Oct 1973). (In Russian).

Kinetics of the photo- and radiation-induced oxidation of substituted phenols in water solution saturated with oxygen was investigated. In the first part of the work two Hg-lamps (1.0 and $1.5 \cdot 10^{16}$ quantum/ml/sec respectively) and in the second, a γ-cell of ^{60}Co ($2.5 \cdot 10^{14}$ eV/ml/sec) were used. The list of phenols used and experimental oxidation rate constants are presented (k_1 and k_2 are the rate constants for photooxidation correspondingly in 10^{-3} M and 10^{-4} M solutions; k'' is the rate constant for radiolytic oxidation in 10^{-4} M solutions). The modified constants of oxidation rate were calculated from the decrease in the phenol concentration as a function of radiation dose. The calculations permit avoiding the influence of the differences in the radiation intensity and radiations of different energy levels. For correlation analysis of the data an automatic least-square correlation program and electronic digital computer were used. The published values of δ^+ and δ^0 constants were used. The results of correlation analysis are given. A satisfactory fit of the equation to the experimental data in the case of photooxidation indicates the transfer of the substituent-influence only by the inductivity. The negative values of ρ^0 show the electrophilic character of the limiting step of the total reaction. The special ortho-effects seem to play no role in the case of photooxidation (the ρ^0 values and other correlation characteristics do not change when the data for the ortho-substituted phenols are involved. The correlation of experimental data obtained for the radiation-induced oxidation seems to be satisfactory within the range of the equation only in the case of meta-substituted phenols. The fit of experimental data for ortho-, meta- and para-substituted derivatives is not as good. This indicates the appearence of the resonance influence of the substituents. The data obtained for the polyphenols can be correlated well only without taking into account the statistic factor. This fact and the signs of parameters in the correlation equation lead to a conclusion that the limiting step of the reaction involves the phenolate ion and the formal ρ^0 value is in fact the algebraic sum of ρ^0 parameters for phenol ion reaction and the dissociation of phenol. Thus, the ρ^0 value for the reaction of the phenolate ion is negative and, consequently, during the activation a positive charge develops at the reaction center with simultaneous formation of a relatively weak resonance center of electron acceptor character. It follows that radiation-induced oxidation may have a free radical character. (auth)

18321 APPLICATION OF IONIZING RADIATION TO THE LIQUID PHASE REACTION. Machi, S.; Kawakami, W. (Japan Atomic Energy Research Inst., Takasaki). Genshiryoku Kogyo; 19: No. 5, 21-24(May 1973). (In Japanese).

Electron accelerators have been applied only to thin layer reaction because of their short range, in spite of having many advantages when compared to ^{60}Co. If electrons are to be utilized to liquid phase reaction, it is necessary to note that initiating reaction speed is not distributed uniformly due to the unevenness of dose rate distribution in a reaction system, and the dose rate of irradiated portion is very high. Meanwhile, the reaction speed in most of radiation chemistry reaction is not proportional to dose rate. Then, the uniformalization of reaction under distributed dose rate by stirring is analyzed through consideration using a diffusion model and a circulating flow model, for the problems of reaction operation, especially how the reaction speed or polymerization speed are affected by stirring. An example of polymerization by the use of an electron accelerator is introduced. It is indicated that radical concentration distribution can be unified by stirring even in a system in which the initiating reaction is occurring unevenly. The effect of stirring on polymerization speed is also shown. (JA)

18322 SECONDARY REACTIONS OF FREE RADICALS IN IRRADIATED FROZEN AQUEOUS SOLUTIONS OF AMINO ACIDS AND PEPTIDES. Usatyi, A. F.; Panin, V. Y. Biofizika; 18: No. 3, 439-446(May 1973). (In Russian).

Secondary free-radical reactions in irradiated frozen aqueous solutions of 1M amino acids and 0.1M peptides were studied by an EMR method. Radicals, R_1, formed by deamination of the amino acids, entered into intermolecular reactions of detachment of H atoms from amino acid residues of neighboring peptide molecules (170 to 230°K). Localization of free valences was accompanied by corresponding transformations in EMR spectra. The final spectrum was observed by the ~NH−CR−CO~ radical, where R = H or CH_3, etc. Two stages of the process were established. The activation energy of the "fast" stage does not depend on the concentration of the reagents but is determined by their structure. The "slow" stage is diffusion-controlled. In the NMR−H(D) spectrum of solutions of irradiated peptides, signals of fragments of R_a−H non-radical products of secondary reactions are observed. (tr-auth)

18323 METHYL RADICALS IN SOLID ACETONITRILE: DECAY OR NO DECAY. Sargent, F. P.; Bailey, M. G.; Gardy, E. M. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Can. J. Chem.; 52: No. 11, 2171-2174(1 Jun 1974).

A comparison of both the ESR spectra and the thermal stability of the radicals produced in γ radiolysis and 185 nm photolysis of acetonitrile shows that the former are not free methyl radicals. The initial species formed by γ radiolysis can be converted by photobleaching into a methyl radical weakly associated with a cyanide ion. The methyl radical of this CH_3-CN^- pair decays via hydrogen abstraction, whereas the free methyl radicals produced by 185 nm photolysis of acetonitrile are quite stable at 77°K. The low energy of activation for the hydrogen abstraction reaction in the γ irradiated samples is ascribed not primarily to quantum mechanical tunnelling but to perturbation by the cyanide ion. (auth)

18324 ELECTRON SPIN RESONANCE STUDY OF RADICALS FORMED BY γ-IRRADIATION OF 1-SUBSTITUTED 5-NITRO-AMINO AND 5-NITROSO-AMINOTETRAZOLES. Catton, R. C. (Malaspina College, Nanaimo, B. C.); Butler, R. N. Can. J. Chem.; 52: No. 8, 1248-1252(15 Apr 1974).

γ-Irradiation of 1-methyl-5-methylnitro-aminotetrazole (1) and 1-methyl-5-nitro-aminotretrazole (2) resulted in cleavage of the exocyclic N−N bond giving only one detectable radical (NO_2) in each case. The stability and motion of the NO_2 radicals formed in these systems was studied. The NO_2 radical obtained from compound (1) was immobile in the lattice while that obtained from compound (2) was rotating about the y-axis. Irradiation of 1-methyl-5-methylnitroso-aminotetrazole (3) and 1-phenyl-5-nitroso-aminotetrazole (4) did not give a simple N−N bond cleavage and radicals which could not be fully identified were

encountered. The radical obtained from compound (3) appeared to be a nitroxide radical and that obtained from compound (4) appeared to arise from electron capture by the nitrosamino moiety. (auth)

18325 γ-RADIOLYSIS OF LIQUID CYCLOHEXANE CONTAINING DI-N-PROPYL DISULFIDE. Stone, J. A.; Esser, J. (Queen's Univ., Kingston, Ont.). Can. J. Chem.; 52: No. 8, 1253-1257(15 Apr 1974).

Di-n-propyl disulfide is an electron, positive ion, and free radical scavenger in γ-irradiated liquid cyclohexane. The efficiency of electron scavenging is comparable with that of sulfur hexafluoride and the efficiency of H atom scavenging is comparable with that of ethylene. The expected product of cyclohexyl radical scavenging, namely cyclohexylpropyl sulfide, accounts for only about one quarter of these radicals which disappear. No other sulfur-containing products are found. In cyclohexane solutions containing two different disulfides or a disulfide and a thiol a rapid equilibrium of the thiyl groups leads to their distribution between the sulfur-containing species. (auth)

18326 γ-RADIOLYSIS OF ALKANES. II. Liquid-n-Heptane. Armenante, M.; Calicchioo, G. F.; Santoro, V.; Spinelli, N. (Univ., Naples). Int. J. Radiat. Phys. Chem.; 6: No. 3, 177-186(Jun 1974).

The γ-radiolysis products of liquid n-heptane were thoroughly investigated by gas-chromatographic analysis. A comparison was carried out with the results obtained in n-pentane and n-hexane: in particular it is shown that the three distributions of the dimerization products are consistent with a mechanism of formation of the dimers through addition of two thermalized radicals. (auth)

18327 PROCESSES OF FORMATION AND TRANSFORMATION AND TRANSFORMATIONS OF FREE RADICALS BY SIMULTANEOUS OR SUCCESSIVE γ-IRRADIATION AND ILLUMINATION. Pshezhetskii, S. Ya.; Kotov, A. G.; Milinchuk, V. K.; Tupikov, V. I. Int. J. Radiat. Phys. Chem.; 6: No. 3, 159-175 (Jun 1974). (In Russian).

Data on formation and transformations of free radicals obtained by simultaneous irradiation of matter by γ rays and light are presented and discussed. The main radical reactions are dissociation, interaction with molecules, and recombinations. In some cases the radical reactions lead to regeneration of the initial radical, causing the destruction of a plurality of molecules. This is of interest in view of the stability of substances irradiated simultaneously by ionizing radiation and light. The G(R) values obtained under different conditions of irradiation are given and discussed. (auth)

18328 ESR STUDY OF IRRADIATED SINGLE CRYSTAL P-TERT-BUTYL-PHENYLACETIC ACID. Ero-Gecs, M. (Kozponti Fizikai Kutato Intezet, Budapest). Int. J. Radiat. Phys. Chem.; 6: No. 3, 219-221(Jun 1974).

The stable room temperature radical species in irradiated single crystals of tert-butyl-phenylacetic acid was studied by ESR. The experimental hyperfine and g-tensors are given. (auth)

18329 APPARENT ACTIVATION ENERGY FOR TRAPPED ELECTRON DECAY IN ALKALINE GLASSES. Kroh, J.; Plonka, A. (Politechnika Lodzka, Poland). Int. J. Radiat. Phys. Chem.; 6: No. 3, 211-214(Jun 1974).

In the temperature range 113 to 173°K the apparent activation energy for thermal decay of trapped electrons in 8 mol dm^{-3} NaOH glass is zero. On photobleaching either positive or negative values of the activation energy are observed, depending on the temperature of irradiation. (auth)

18330 KINETIC EVIDENCE FOR EXCITED WATER IN THE COBALT-60 γ-RADIOLYSIS OF FERROUS SULPHATE IN 0.4 MOL DM SULPHURIC ACID SOLUTIONS. Matthews, R. W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). J. Chem. Soc., Faraday Trans., I; 70: No. 7, 1384-1393(1974).

The effect of oxygen and ferrous ion concentrations on $G(Fe^{3+})$ from ferrous sulphate in 0.4 mol dm^{-3} sulphuric acid solution irradiated with ^{60}Co γ rays has been studied. The results cannot be fully explained in terms of the accepted reaction mechanism. The marked increase in $G(Fe^{3+})_{deaer.}$ with ferrous ion concentration is attributed to a reaction between ferrous ion and excited water in competition with pseudo first-order decay of the excited water. In the presence of oxygen the results are consistent with a competing reaction between excited water and oxygen to give hydrogen sesquioxide, H_2O_3, or singlet oxygen, $O_2(^1\Delta_g)$. Homogeneous kinetics describe the data with good precision for ferrous ion concentrations ranging from 0.2 to 100 mmol dm^{-3} and for oxygen concentrations ranging from 0.0 to 1.1 mmol dm^{-3}. The method of least-squares was used to obtain the following parameters from the data: $G_H = 3.67 \pm 0.03$, $k_{H,Fe^{3+}}/k_{H,O_2} = (12.0 \pm 0.5) \times 10^{-4}$; $G(Fe^{3+})_{deaer.}$ (at $[Fe^{2+}] = 0$) = 7.68 ± 0.04, $G_{H_2O^\bullet} = 0.49 \pm 0.05$, $k_{H_2O^\bullet}/k_{H_2O^\bullet,Fe^{3+}} = (15.0 \pm 4.0) \times 10^{-3}$, $k_{H_2O^\bullet,O_2}/k_{H_2O^\bullet,Fe^{3+}} = 11.7 \pm 3.2$. The lifetime of the excited water is estimated to be not less than 10^{-7} s. (auth)

18331 RADIOLYSIS OF PYRIMIDINES IN AQUEOUS SOLUTIONS. III. Micellar Effects on Product Yields Formed in the Interaction of Hydrated Electrons, Hydrogen Ions, Hydroxyl, and Chlorine Radicals with Thymine and Uracil. Fendler, J. H.; Infante, G. A.; Jirathana, P.; Fendler, E. J. (Texas A and M Univ., College Station). J. Chem. Soc., Faraday Trans., I; 70: No. 7, 1171-1179(1974).

Micellar surfactants decrease the yield of products formed in the interaction of e^-_{aq}, ·H, ·OH and Cl_2^- with uracil and thymine far in excess of the decrease expected on the basis of simple competition of these species for the pyrimidines and the surfactants. Additionally, in the presence of micelles percentages of some of the radiolytic products of thymine, particularly the dimers, decrease at the expense of the glycols. Effects on uracil are smaller than those on thymine. These results are explicable in terms of interactions between the product-forming intermediate species with the micelles and the significance of this behavior is discussed. (auth)

18332 GAMMA AND PULSE RADIOLYSIS OF TETRACYANONICKELATE(II) ANION IN AQUEOUS SOLUTION. Mulazzani, Q. G.; Ward, M. D.; Semerano, G.; Emmi, S. S.; Giordani, P. (Consiglio Nagionale delle Ricerche, Bologna). Int. J. Radiat. Phys. Chem.; 6: No. 3, 187-201(Jun 1974).

On radiolysis in aqueous solution $Ni(CN)_4^{2-}$ is reduced to $Ni_2(CN)_6^{4-}$ by the radical ion CO_2^-. A reaction mechanism is proposed. The yield of $Ni_2(CN)_6^{4-}$ is 2.4 molecules per 100 eV and the rate constants are $k_7 = (1.17 \pm 0.07) \times 10^9$ dm^3 mol^{-1} s^{-1}, $k_8 = (8.1 \pm 1.0) \times 10^3$ s^{-1} and $k_9 = (7.4 \pm 1.0) \times 10^7$ dm^3 mol^{-1} s^{-1}. Spectra of the intermediate species are reported. In the presence of methanol as a radical scavenger the yield of $Ni_2(CN)_6^{4-}$ is much lower and this is explained on the basis of a reaction between the CH_2OH radical and $Ni_2(CN)_6^{4-}$ or its precursors. The following rate constants are also reported, $k_{(Ni(CN)_4^{2-} + H)} = (1.8 \pm 0.2) \times 10^{10}$ dm^3 mol^{-1} s^{-1} and $k_{(Ni(CN)_4^{2-} + OH)} = (9.1 \pm 0.5) \times 10^9$ dm^3 mol^{-1} s^{-1}. The spectra of $HNi(CN)_4^-$ and $Ni(CN)_4^-$ are given. (auth)

18333 RADIOLYSIS OF PYRIMIDINES IN AQUEOUS SOLUTIONS. II. Product Formation in the Interaction of Hydrated Electrons, Hydrogen Ions, Hydroxyl, and Chlorine Radicals with Uracil. Infante, G. A.; Jirathana, P.; Fendler, E. J.; Fendler, J. H. (Texas A and M Univ., College Station). J. Chem. Soc., Faraday Trans., I; 70: No. 7, 1162-1170(1974).

Product yields in the reaction of e^-_{aq}, ·H, ·OH and Cl_2^- with uracil and $uracil^-$ were determined quantitatively in ^{60}Co γ-irradiated aqueous uracil solutions in the presence of suitable scavengers. Good material balances between G(–uracil) and G(total products) were obtained in all cases. The products determined were: uracil dimer, alloxan, alloxantin, uracil cis-glycol, uracil trans-glycol, dialuric acid, isobarbituric acid, 5-hydroxydihydrouracil, 6-hydroxydihydrouracil, dihydrouracil, formylurea, 5-hydroxyhydantoin, parabanic acid, urea and alcohol adducts. Based on the yields of these products and the available literature, mechanisms are proposed and discussed. (auth)

18334 KINETICS OF COLOR CHANGE IN $LiNbO_3$ UPON IRRADIATION AND ANNEALING. Soroka, V. V.; Khromova, N. N.; Klyuev, V. P. Zh. Prikl. Spektrosk.; 20: No. 3, 541-543(Mar 1974). (In Russian).

The kinetics of the radiation coloring during γ irradiation and thermal bleaching were studied in a series of $LiNbO_3$ crystals of different quality. The character of the radiation coloring as a whole is similar for different crystals and makes it possible to conclude that in addition to potential centers of radiation color in $LiNbO_3$ crystals there are at least two types of defects affecting the kinetics of the radiation coloring and that γ radiation from Co sources causes substantial structural changes in the $LiNbO_3$ crystals. The kinetics for the annealing of the radiation coloration in different crystals coincides within the limits of measurement error and is characterized by an activation energy of (0.31 ± 0.02) eV. (tr-auth)

18335 MOESSBAUER SPECTROSCOPIC INVESTIGATION OF IRON ACETYLACETONATE IRRADIATED WITH α-PARTICLES. Sokol'skii, D. V.; Khlystov, A. S.; Dautov, L. M. Dokl. Phys. Chem.; 213: No. 4-6, 1115-1116(Dec 1973).

Translated from Dokl. Akad. Nauk SSSR; 213: No. 4, 1132-1133(Dec 1973).

The radiation degradation of iron acetylacetonate $Fe(C_5H_7O_2)_3$ under the action of α particles was studied by chromatography, Moessbauer, and ESR spectroscopy methods and the results were compared with those obtained under reactor radiation. The sam-

ples were irradiated at particle energies of 30, 40, and 50 MeV with the integral flux varying from 10^{13} to 10^{15} α/cm^2. The absorption spectra and the Moessbauer parameters show the appearance of bivalent Fe in the irradiated samples indicating the radiolytic reduction of Fe. The ESR spectra of the irradiated samples did not show free radicals. Chromatographic studies showed the presence of products to be expected from the recombination of free radicals. The amount of bivalent Fe was proportional to the flux and did not depend on the energy of the incident particle. As with reactor radiation the Moessbauer lines undergo contraction, and the yield of bivalent Fe is almost equivalent under the two forms of irradiation. The radiation defect of the two types of irradiation differ substantially; neutrons form displaced atoms and α particles form new stable impurity compounds. (JSR)

18336 DIMERIZATION OF α,β,β-TRIFLUOROSTYRENE UNDER THE INFLUENCE OF γ IRRADIATION. Fokin, A. V.; Landau, M. A.; Vtorygin, S. M.; Yakutin, V. I.; Volkova, E. V. Bull. Acad. Sci., USSR, Div. Chem. Sci. (Engl. Transl.); 22: No. 12, 2705-2707(Dec 1973).

Translated from Izv. Akad. Nauk SSSR, Ser. Khim.; 22: No. 12, 2773-2775(Dec 1973).

The ^{60}Co γ-irradiation of trifluorostyrene results in its dimerization with the formation of a mixture of two diphenylhexafluorocyclobutane isomers. (auth)

18337 RADIATION ACTIVITY OF HYDROGENATION CATALYSTS. Sokol'skii, D. V.; Nadykto, B. T.; D'yakova, G. A. (Inst. of Organic Catalysis and Electrochemistry, Alma Ata, USSR). Dokl. Phys. Chem.; 212: No. 4-6, 907-908(Oct 1973).

Translated from Dokl. Akad. Nauk SSSR; 212: No. 6, 1386-1388 (Oct 1973).

The effect of preliminary thermal neutron irradiation of γ-Al_2O_3 on the catalytic activity of Pt, Pd, and Rh deposited from 5.0 and 0.5% aqueous solutions was studied. The catalytic activities were compared by hydrogenation of dimethylethynylcarbinol. The greatest change in activity was observed for Pt catalyst. Analysis of kinetic and potentiometric curves for the hydrogenation on Pt catalysts showed that the hydrogenation rate in the use of an irradiated carrier was increased by a factor of more than 10 for the 5.0% Pt and a factor of 49.5 for the 0.5% Pt. Temperature increase led to some reduction of the increase in activity. The values of the potential shifts of the Pt on the irradiated carrier were more anodic than the values of catalysts adsorbed on nonirradiated carrier. The previous irradiation substantially increased the catalytic properties of Pd and Rh also. (JSR)

18338 CONTRIBUTION TO THE RADIATION PREPARATION OF WOOD–PLASTIC MATERIALS. I. Radiation-Induced Polymerization of Styrene in Preparation of Wood–Plastic Combination. Piatrik, M.; Varga, S. (Slovak Technical Univ., Bratislava). Radiochem. Radioanal. Lett.; 18: No. 2, 61-67 (15 Jul 1974).

The conditions of the application of styrene and its systems for radiation preparation of wood-plastic materials were investigated (WPC). The basic parameters were studied, and the kinetic parameters of radiation polymerization process for styrene block polymerization and for the polymerization of styrene embodied in wood at a dose rate of ~0.45 Mrad/hr were determined. (auth)

18339 CONTRIBUTION TO THE RADIATION PREPARATION OF WOOD–PLASTIC MATERIALS. II. The Possibilities of Reduction of Absorbing Doses for the Radiation Polymerization of Styrene–Wood Combinations. Varga, S.; Piatrik, M. (Slovak Technical Univ., Bratislava). Radiochem. Radioanal. Lett.; 18: No. 2, 69-75(15 Jul 1974).

The possibility of reducing the absorbed radiation doses, necessary for total polymerization in the radiation preparation of wood-plastic materials (WPC) using styrene, was studied. The influence of various halogen compounds, solvents, chemical initiators, wood extraction, pre-irradiation of wood before its impregnation by styrene on the rate of the radiation polymerization reaction of styrene incorporated in wood was also studied. (auth)

18340 CONTRIBUTION TO THE RADIATION PREPARATION OF WOOD–PLASTIC MATERIALS. III. Radiation-Induced Copolymerization of Styrene and Acrylonitrile in Preparation of Wood–Plastic Combination (WPC). Piatrik, M.; Varga, S. (Slovak Technical Univ., Bratislava). Radiochem. Radioanal. Lett.; 18: No. 2, 77-82(15 Jul 1974).

The conditions of the preparation of WPC from the monomer mixture: styrene–acrylonitrile were studied. The influence of the mixture composition, CCl_4, chemical initiator, chloroprene, and the constituents of the wood on the speed of the polymerization of the monomer mixture: styrene–acrylonitrile in poplar and beech wood were examined. (auth)

18341 FLASH PHOTOLYSIS OF INTERMEDIATES IN HYDRATED ELECTRON REACTIONS. Vidyarthi, S. K. Vancouver, Canada; Univ. of British Columbia (1973). National Library of Canada, Ottawa.

Thesis (Ph.D.).

A triple flash photolysis apparatus is described. Hydrated electrons (e^-_{aq}) produced by uv flash photolysis of some common inorganic anions (OH^-, $SO_4^{=}$) were monitored at 633 nm. This species was identified by its absorption spectrum and by the effect of well known electron scavengers. In the absence of an electron scavenger, e^-_{aq} decayed largely by a second order process to form a comparatively long lived ($\tau \sim 5$ms) intermediate, X. Results indicate that X is probably a dimeric hydrated electron, $(e_2^-)_{aq}$ or a product therefrom and can be photodissociated in the 300 to 400 nm region to regenerate hydrated electrons. Metal ions Ag^+ and Tl^+ react with e^-_{aq} to produce the respective short lived metal atoms (hyper-reduced states), which also regenerate e^-_{aq} by a second flash. $M^* + h\nu$ ($\lambda \sim 300$ nm) $\rightarrow M^+ + e^-_{aq}$. Ag^* has an absorption spectrum with λ_{max} at 315 nm and an oscillator strength of 0.63. This band is assigned as charge-transfer-to-solvent (CTTS). Acetone, which reacts rapidly with e^-_{aq}, produces a transient, presumably $(CH_3)_2CO^-$, at pH 11. The absorption spectrum of this transient was recorded, ($\lambda_{max} = 255$ nm, $\epsilon_{max} \approx 1.3 \times 10^4$ M^{-1} cm^{-1}) and its photolysis in this region was again shown to regenerate e^-_{aq}. Hence, it seems that the absorption spectra of many such transients may be CTTS bands in that they produce e^-_{aq} upon photolysis. The decay of e^-_{aq} was followed in the presence of some inorganic gases, e.g., SF_6, N_2O, and Xe. The possibility of intermediate formation in those reactions is discussed. The carbonate radical ion, CO_3^-, was produced during the flash photolysis of an N_2O saturated alkaline (pH 11) solution containing CO_2 and was studied by its absorption spectrum and decay kinetics. It was demonstrated that $HCOO^-$ ions, methanol or 2-propanol, commonly used OH scavengers, yield e^-_{aq} upon flash photolysis. (Diss. Abstr. Int., B)

18342 A SIMPLE CHEMICAL MODEL FOR THE ELECTRON POLARIZATION OF CYCLOPENTYL RADICALS PRODUCED IN RADIOLYSIS. Wong, S. K.; Wan, J. K. S. (Queen's Univ., Kingston, Ontario (Canada). Dept. of Chemistry). Chem. Phys.; 4: No. 2, 289-294(May 1974).

The electron polarization of cyclopentyl radicals was observed by Smaller et al. An attempt is made to account for this observation by an initial polarization mechanism. The mechanism is based on the addition of hydrogen atoms to the product olefin to give the alkyl radicals. The electron polarization of the alkyl radicals arises from the polarized hydrogen atoms. It should be emphasized that the processes leading to polarized H atoms are not established but it is assumed that they are formed initially with the populations in $\alpha_e\alpha_N$ and $\alpha_e\beta_N$ being greater than $\beta_e\alpha_N$ and $\beta_e\beta_N$, respectively. (auth)

18343 PRESENCE OF FORMIC ACID IN IRRADIATED MAIZE STARCH. Dauphin, J. F.; Athanassiadis, H.; Berger, G.; Saint-Lebe, L. (CEA Centre d'Etudes Nucleaires de Cadarache, 13-Saint-Paul-les-Durance (France)). Staerke; 26: No. 1, 14-17 (Jan 1974). (In French).

4 figs.; 4 tabs.; 18 refs.

Formic acid occurs in relatively large amounts during gamma irradiation of maize starch (100 μg/g/Mrad, in oxygen). It represents the main part of radioinduced free acidity. The influence of several parameters was determined: irradiation conditions (dose, dose rate, temperature, surrounding gas), storage temperature, starch characteristics (moisture, impurities), heat treatment. A formation process is proposed. (auth)

Radiochemistry and Nuclear Chemistry

Refer also to abstract 19477.

18344 (COO-2184-6) NUCLEAR CHEMISTRY PROJECT. Renewal Proposal and Progress Report, October 1, 1974–September 30, 1975. Naumann, R. A. (Princeton Univ., N. J. (USA)). 26 Jun 1974. Contract AT(11-1)-2184. 36p. Dep. NTIS $5.00.

The research program was concerned with three main areas: nuclear structure and reactions, nuclear hyperfine interactions in metals and chemical compounds, and experimental and theoretical investigations of the chemical effects accompanying muon capture in chemical compounds. The research program is described in general, and then specific reports are given. Three of the reports are title listed separately. (RWR)

For title listings of individual papers see: 20090, 20091, and 20108.

18345 RADIOELECTROCHEMISTRY: A REVIEW. Raaen, H. P. (Oak Ridge National Lab., TN). Anal. Chem.; 46: No. 9, 1265-1292(Aug 1974).

The conjoint use of radioisotopes with electrochemistry is reviewed. The major subjects considered are: electrode behavior, electric-double-layer structure, mechanisms and kinetics of processes that occur at electrodes, electrochemical behavior of certain substances, radioelectrochemical analysis, and radiation electrochemistry. A few uses of radionuclides in microcoulometry and in the study of the direct conversion of ionizing radiation to electrical energy are included. The works selected for citation describe studies of conducting surfaces in fluid systems and the charge-transfer reactions involved; thus, they include corrosion as related to the behavior of electrodes but exclude semiconduction. Finally, those areas of electrochemistry are suggested which offer considerable possibility for exploration with radionuclides. (auth)

18346 RADIOCHEMICAL STUDY OF REACTION OF TRICHLOROGERMANE WITH CARBON TETRACHLORIDE. Isagulyants, G. V.; Klimov, A. P.; Kolesnikov, S. P.; Perl'mutter, B. L.; Nefedov, O. M. (Inst. of Organic Chemistry, Moscow). Bull. Acad. Sci., USSR, Div. Chem. Sci. (Engl. Transl.); 22: No. 12 2758-2760(Dec 1973).

Translated from Izv. Akad. Nauk SSSR, Ser. Khim.; 22: No. 12, 2821-2823(Dec 1973).

The reaction of trichlorogermane with CCl_4 at 75°C leads mainly to the formation of $HCCl_3$ and $GeCl_4$. The yield of CCl_3GeCl_3 under these conditions is 17%, in which connection its formation, based on the radiochemical study data, proceeds by the carbenoid mechanism, i.e., via the transfer of $GeCl_2$ from trichlorogermane to CCl_4. The participation of $HGeCl_3$ as a possible intermediate compound in the reaction of the complex $C_4H_8O_2 \cdot GeCl_2$ with CCl_4, and probably with other organic halides, should be rejected. (auth)

Hot-Atom Chemistry

18347 OXIDATION STATES OF COBALT IN THE ^{60}Co RECOIL SPECIES IN BENZENE SOLUTIONS OF NEUTRON-IRRADIATED TRIS(ACETYLACETONATO) COBALT(III). Tominaga, T.; Nishi, Y.; Motohashi, E. (Tokyo Univ.). Radiochem. Radioanal. Lett.; 18: No. 1, 15-22(2 Jul 1974).

Atmospheric oxygen was found to be necessary for the formation of $Co(acac)_3$ in $Co(acac)_3$ benzene solutions. The reformation of $^{60}Co(acac)_3$ with time in benzene solutions of the irradiated solid $Co(acac)_3$ was also found to be suppressed remarkably in the absence of atmospheric oxygen. Hence it is likely that at least 50% of the ^{60}Co recoil species in the solutions consist of $^{60}Co(II)$ species. (auth)

18348 RADIOCHEMISTRY OF ORGANOIRON COMPOUNDS. IV. $FeCp(CO)_2$. Kanellakopulos-Drossopulos, W. (Kernforschungszentrum, Karlsruhe, Ger.); Wiles, D. R. Can. J. Chem.; 52: No. 6, 894-899(15 Mar 1974).

The radiochemical yields of $[Cp\,^{59}Fe(CO)_2]\cdot$ in neutron-irradiated $[CpFe(CO)_2]_2$ and $[CpFe(CO)_2]I$ are 6.9 and 14.8% respectively. Other prominent products are $[CpFe(CO)_2]_2{}^{59}Fe$, $^{59}Fe(CO)_5$, and $^{59}FeCp_2$, in both target compounds. Thermal treatment at 75°C increases the yields of $^{59}Fe(CO)_5$, and of the radioactive target compound in both cases, and does not affect the yields of the other two products. The radioactive radical $[Cp^{59}Fe(CO)_2]$ is stable to 75° in the solid $[CpFe(CO)_2]_2$, and on dissolution is rapidly scavenged by iodine transfer from carrier $[CpFe(CO)_2]I$. It is suggested that complex molecular products are not reformed following the nuclear activation, but are rather preserved during and despite the nuclear reaction. An effective "hot zone" need not contain more than two or three molecules. Production of $[Cp^{59}Fe(CO)_2]\cdot$ and $[Cp^{59}Fe(CO)_2]_2$ is observed in neutron-irradiated solutions of $Fe(CO)_5$ and benzene with either $FeCp_2$ or C_5H_6. (auth)

18349 RECOIL TRITIUM REACTIONS WITH CARBON–CARBON SINGLE BONDS. Williams, J. L. College Station, TX; Texas A and M Univ. (1973). 155p. University Microfilms Order No. 74-13,118.

Thesis (Ph. D.).

Recoil tritium atoms were allowed to react in hexafluorocyclobutene-moderated systems with hydrocarbons of the general formula R_1-CH_3. The CH_2T yields per bond from the hot tritium abstraction of end methyl groups from alkanes, alkenes, and alkynes were correlated inversely with the R_1-CH_3 bond dissociation energies. Other parameters postulated to control hot atom reactions, such as mass, size, and electron density, were also examined and found not to exert a major influence in determining the CH_2T yields. On the basis of incomplete employment of allyl resonance in abstraction of the terminal methyl group from 1-butene, the time scale for that and similar reactions was set at $2\text{-}5 \times 10^{-14}$ sec. The predominance of chemical parameters in controlling the yields from hot atom reactions suggest that certain collisional complexes can be proposed. In one possible complex, the recoil tritium attacks along the R_1-CH_3 bond axis, resulting in a linear complex in which the cleavage of the bond should be the rate-differentiating factor. The other possible complex is triangular in nature, with the recoil tritium attacking in a direction perpendicular to the R_1-CH_3 bond; it is the electron overlap process and the C–T bond formation process which should be rate-differentiating in this complex. The experimental findings in this work suggest two different mechanisms for recoil tritium atoms interacting with carbon–carbon single bonds. One mechanism calls for the linear complex to be the major contributor to the CH_2T yield while the triangular complex accounts for a minor portion. The major support for this mechanism is the inverse correlation of CH_2T yields per bond with the R_1-CH_3 bond dissociation energies. This mechanism proposes a methyl abstraction reaction analogous to the hydrogen abstraction. The second mechanism has the triangular complex as the major contributor to the CH_2T yield. In the triangular complex, a competition between R_1 and CH_3 for the tritium atom could result. In this case, the CH_2T yield should vary inversely to the ease of formation of the R_1T bond, a stronger bond being able to compete for the tritium atom better than a weaker bond. The exact parallel between R_1-CH_3 and R_1-T bond dissociation energies means that both proposed mechanisms are consistent with the data obtained to the present. But both models, however, depend on chemical parameters, rather than physical parameters, to determine the yields from recoil tritium reactions at carbon–carbon single bonds. (Diss. Abstr. Int., B)

18350 GAS PHASE SUBSTITUTION OF HALOGEN IN HALOALKANES BY NUCLEAR RECOIL ^{18}F ATOMS. Iyer, R. S. Irvine, CA; University of California (1973). 373p. University Microfilms Order No. 74-13,849.

Thesis (Ph. D.).

The substitution of a halogen atom in a haloalkane by nuclear recoil ^{18}F was investigated in the gas phase using various substrate molecules. The ^{18}F atoms were produced by the ^{19}F-(n,2n)^{18}F nuclear reaction using fast neutrons. SF_6 was used as the source of ^{19}F for the nuclear reaction and was the major component in most of the samples used in this study. The high recoil energy ($>10^5$ eV) of the ^{18}F formed causes it to break loose from the parent molecule and also to become ionized. Upon slowing down to chemical energy range and neutralization, the reactions of ^{18}F atoms with the substrate molecules can occur. The substitution of F in SF_6 by ^{18}F occurs with a yield of 1% in the gas phase at pressures greater than 1000 Torr. The only other identified product in "pure" SF_6 is $SO_2F^{18}F$, which is formed in much smaller yields. The measurement of $SF_5{}^{18}F$ yields in neon moderated samples and application of the kinetic theory of hot atom reactions to the data indicates that SF_6 is 1.5 times more efficient than neon as a moderator for energetic ^{18}F atoms. The "inertness" of SF_6 toward reaction with ^{18}F atoms and its high efficiency as moderator for hot ^{18}F atoms are useful properties in focusing the ^{18}F reactions onto substrate molecules. These properties have been used in many other studies of ^{18}F reactions. In mixtures of methyl halides with excess SF_6, the ^{18}F-for-X substitution (X = F, Cl, Br, and I) occurs in yields less than 1%. This substitution yield was found to increase in the order $CH_3F < CH_3Cl < CH_3Br > CH_3I$ at a given mole fraction of the methyl halides. Measurements of the $CH_3{}^{18}F$ yields as a function of CH_3X mole fraction in SF_6-CH_3X mixtures showed that the ^{18}F-for-F substitution in CH_3F is purely a hot process, while small yields of thermal ^{18}F-for-X substitutions are observed in CH_3Cl, CH_3Br, and CH_3I. The thermal component to the substitution yield was found to increase in the order $CH_3Cl < CH_3Br < CH_3I$. These results are explained by the postulate that the ease of ^{18}F-for-X substitution in these molecules increases with decreasing bond dissociation energy of the C-X bond. A model is proposed for these reactions which assumes that the average energy at which the ^{18}F-for-X substitution occurs shifts to lower energies with decreasing C-X bond energy and that the reaction cross section extends to thermal energies of the ^{18}F atoms in the case of CH_3Cl, CH_3Br, and CH_3I. The ^{18}F-for-X substitution yields were measured also in CF_4, CF_3Br, CF_3I, $(CH_3)_2CHCl$, C_2H_5Br, and $(CH_3)_3CHBr$. In samples of these molecules with excess SF_6, the ^{18}F-for-X substitution yield was found to be considerably lower than in the corresponding methyl halide, except in the case of CH_4. No near-thermal substitution occurs in these molecules. The absence of a thermal yield in CF_3X (X = Br or I) and in $(CH_3)_{3-n}H_nX$ cannot be explained in terms of the C-X bond dissociation energies, since they are quite similar to those of the corresponding CH_3X molecules. The near-thermal substitution of ^{18}F-for-X is facilitated by H substituents on the C-X carbon atom, and is much less likely for CH_3 or F substituents. The hypothesis that

these near-thermal ^{18}F-for-X substitution reactions occur with inversion of configuration at the carbon atom offers a possible explanation for these results. (Diss. Abstr. Int., B)

Properties of Radioactive Materials

Refer also to abstracts 18214, 19066, and 19109.

18351 QUENCHING OF EXCITED URANYL IONS BY ALIPHATIC ALCOHOLS IN AQUEOUS SOLUTIONS. Sergeeva, G. I.; Chibisov, A. K.; Karyakin, A. V.; Levshin, L. V.; Nemodruk, A. A.; Myasoedov, B. F. (Moscow State Univ.). High Energy Chem. (USSR) (Engl. Transl.); 8: No. 1, 30-33(1974).

Translated from Khim. Vys. Energ.; 8: No. 1, 38-42(1974).

Pulse photolysis was used for a quantitative investigation of two competing processes: induced internal conversion of excited uranyl ions ($U^{*(6+)}$) and abstraction of a hydrogen atom from an alcohol via reaction with $U^{*(6+)}$. Rate constants of the investigated processes were determined. The absorption spectrum of pentavalent uranium, an intermediate product in the photoreduction of uranyl by alcohols, was measured. (auth)

18352 ELECTROCHEMILUMINESCENCE OF URANYL AND LANTHANIDE SULFURIC ACID SOLUTIONS. New Bright Chemiluminescent Reaction. Kazakov, V. P.; Bulgakov, R. G.; Parshin, G. S. (Inst. of Chemistry, Ufa, USSR). Dokl. Akad. Nauk SSSR; 214: No. 1, 139-141(1 Jan 1974). (In Russian).

The electrochemiluminescence of sulfuric acid solutions containing the lanthanide (Ln^{3+}) and uranyl (UO_2^{2+}) ions was examined. A new chemiluminescent reaction was identified. This reaction appeared during the electrochemical reduction of sulfuric acid containing uranyl and ozone. It was found that the uranyl complexes are energy acceptors of the oxidation of the S by the ozone; the lanthanide ions Tb^{3+} and Dy^{3+} also successfully filled this role. The detection of the new bright electrochemiluminescent reaction is assumed with excitation of the 4+ and 5+ elements. (tr-auth)

18353 IR SPECTRA AND STRUCTURE OF SOME SOLID URANIUM(IV) COMPLEXES WITH OXYGEN-DONOR LIGANDS. Hanuza, J.; Jezowska-Trzebiatowska, B.; Janczak, C. (Inst. of Low Temperature and Structure Research, Wroclaw). Acta Phys. Pol.; A45: No. 6, 885-899(Jun 1974).

The present paper contains the results of studies on infrared spectra of uranium(IV) complexes over the 200-4000 cm^{-1} range such as $UL_2 \cdot n(aq)$ and $UL_4 \cdot n(aq)$ where L is the sulfate, acetate or oxalate anion. Each band was assigned a definite vibration mode of the functional group. A qualitative analysis of the spectra has been carried out for an eight-coordinated of the UO_8 type and that of UO_6 type compounds, thus making it possible to establish the structures and coordination number of the solid uranium(IV) complexes with oxygen donor ligands. (auth)

18354 MAGNETIC PROPERTIES OF THE TRICHLORIDES, TRIBROMIDES, AND TRIIODIDES OF U(III), Np(III), AND Pu(III). Jones, E. R., Jr. (Univ. of South Carolina, Columbia); Hendricks, M. E.; Stone, J. A.; Karraker, D. G. J. Chem. Phys.; 60: No. 5, 2088-2094(1 Mar 1974).

Magnetic susceptibilities of uranium, plutonium, and neptunium trichlorides, tribromides, and triiodides were measured from 2.7°K to as high as 240°K with a vibrating-sample magnetometer at applied fields up to 12 kOe. Antiferromagnetic transitions were observed in UCl_3, $T_N = 22.0 \pm 1.0$°K; in UBr_3, $T_N = 15.0 \pm 0.5$°K; in UI_3, $T_N = 3.4 \pm 0.2$°K; and in $PuCl_3$, $T_N = 4.5 \pm 0.5$°K. A ferromagnetic transition at $T_c = 4.75 \pm 0.1$°K was found for PuI_3, and a slight hysteresis was measured at 2.7°K. Temperature-independent paramagnetism was observed for $NpCl_3$ below 50°K, for α-$NpBr_3$ below 30°K, and for NpI_3 below 15°K. All these latter compounds, and $PuBr_3$, exhibited Curie-Weiss paramagnetism at higher temperatures, with effective moments near the free-ion moments. The experimental magnetic susceptibility of $PuCl_3$ from 10 to 100°K agrees with the susceptibility calculated from crystal field energy levels and wavefunctions. (auth)

18355 SOLUBILITY OF SOME URANIUM COMPOUNDS IN SIMULATED LUNG FLUID. Cooke, N, Holt, F. B. (British Nuclear Fuels Ltd., Springfields). Health Phys.; 27: No. 1, 69-77(Jul 1974).

Solubility studies, using a simulated lung fluid, have been carried out on a number of uranium compounds used in the manufacture of nuclear fuel elements in the Springfields Works of British Nuclear Fuels Limited. The work was concerned with those compounds which are sparingly soluble in water, since from operational experience and biological monitoring over many years, the classification of soluble uranium compounds was well established. From the results obtained, it was possible to allocate the compounds investigated to the appropriate biological clearance capacity (days, weeks, years) proposed by the ICRP Task Group on Lung Dynamics. An attempt to relate particle size to solubility did not in general prove successful, but some evidence was obtained to indicate that thermal history may be as, or more, important than particle size, in the particle size ranges investigated. (auth)

18356 RAMAN SPECTRA OF CRYSTALS OF URANYL COMPLEXES WITH REPLACEMENT WITH ^{18}O. Ladygin, I. N.; Mashirov, L. G.; Suglobov, D. N. Zh. Prikl. Spektrosk.; 20: No. 5, 839-843(May 1974). (In Russian).

The laser Raman spectra of monocrystals of $Cs_2UO_2Cl_4$, $Cs_2UO_2Br_4$, and $RbUO_2(NO_3)_3$ with isotope replacement by ^{18}O in the uranyl were obtained. A factor group analysis was made of the oscillations of these crystals. On the basis of the theoretical analysis and polarization characteristics of the spectra an assignment was made of the frequencies observed. Correlation interaction of the completely symmetric oscillation of the substituted and non-substituted uranyl was detected in the mixed crystals. The strong field parameters in the tetrahalogenides of the uranyl complexes were made more precise, leading to large difference in the frequencies of symmetric and antisymmetric oscillation of the uranium-ligand. The stability of the strong constant libration oscillation of the uranyl was noted. (tr-auth)

18357 DISSOCIATION OF UD_3. Pivarc, J. (Inst. of Physics, Bratislava). Radiochem. Radioanal. Lett.; 18: No. 1, 1-6(2 Jul 1974).

The dissociation of uranium deuteride was investigated. The influence of the temperature on the velocity of dissociation of UD_3 is presented. It is shown that the total dissociation of this compound to the uranium and deuterium takes place at 450°C. The velocity of dissociation is negligible at temperatures below 275°C and it is 5 times less than the velocity of dissociation of uranium hydride at about 300°C. The apparatus applied in the investigations is also described. (auth)

18358 SYNTHESIS OF TRITIUM LABELLED DIALKENYL SULPHIDES STRUCTURALLY RELATED TO SULFUR CROSS-LINKS IN VULCANIZED NATURAL RUBBER. Ayrey, G.; Barnard, D.; Houseman, T. H. (London Univ.). J. Label. Compounds; 10: No. 1, 121-134(1974).

Di-(1,3-dimethylbut-2-enyl-[4-$^3H_1$]mono-, di- and trisulfides have been synthesized via the common intermediate S-(1,2-dimenthylbut-2-enyl-[3-$^3H_1$] thiouronium bromide (I). Protonation of a mixture of 2-methyl-penta-1,3- and -2,4-dienes during formation of (I) was shown to be accompanied by a large kinetic isotope effect such that protonation was 8-10 times more probable than tritonation. (auth)

18359 PREPARATION OF 4-IODO-ANTIPYRINE LABELLED WITH ^{125}I. Linhart, J. (Isotope Lab., Prague); Sedmera, P.; Benes, J. Radiochem. Radioanal. Lett.; 18: No. 1, 29-32(2 Jul 1974).

A method is described for the preparation of 4-iodo-antipyrine labelled with ^{125}I. The identity and the purity of the preparation was confirmed by its mass and NMR spectra. (auth)

18360 PREPARATION OF 6-AZAURACIL-5-^3H AND 6-AZAURIDINE-5-^3H OF HIGH MOLAR ACTIVITY. Filip, J.; Skoda, J.; Kradec, H. (Czechoslovenska Akademie Ved, Prague). J. Label. Compounds; 10: No. 1, 59-71(1974).

Catalytic reductive dehalogenation of 5-bromo-6-azauracil with carrier-free tritium led to 6-azauracil-5-^3H of a molar activity of 19.0 Ci/mmole. The reaction conditions for the catalytic reductive dehalogenation were examined in tracer experiments. Microbial transformation was used for the preparation of 6-azauridine-5-^3H from 6-azauracil-5-^3H. 6-azauridine-5-^3H was prepared at a molar activity of 18.8 Ci/mmole. In both compounds the stability of tritium was investigated in an aqueous medium at 100°C. (auth)

18361 Am(V) COMPLEX FORMATION WITH OXALATE IONS. Shilov, V. P.; Nikolaevskii, V. B.; Krot, N. N. (Inst. of Physical Chemistry, Moscow). Zh. Neorg. Khim.; 19: No. 2, 469-473(1974). (In Russian).

Spectrophotometric studies of Am(V) complex formation in oxalate solution at pH 1-5 showed the formation, in stages, of two complexes, $AmO_2C_2O_4^-$ and $AmO_2(C_2O_4)_2^{3-}$. The stability constants at $\mu = 0.25$ and $t = 25.0 \pm 0.1$°C were 1.86×10^3 and 1.25×10^2, respectively. Data on the stability of pentavalent Np, Pu, and Am complexes are compared. (tr-auth)

18362 REGULARITIES IN THE APPEARANCE OF MOLECULAR OSCILLATIONS IN THE LUMINESCENT SPECTRA OF URANYL OXALATE FLUORIDE COMPOUNDS. Belomestnykh, V. I.; Burkov, V. I.; Kizel, V. A.; Krasilo, Yu. I.; Madii, V. A.; Shchelokov, R. N. Zh. Prikl. Spektrosk.; 20: No. 5, 814-817 (May 1974). (In Russian).

Regularities in the appearance of molecular oscillations in the

luminescent spectra of uranyl oxalate fluoride compounds with a complex character for the coordination spheres were studied. It was shown that a significant effect on the structure of the electron oscillation spectra is caused by the dimensions and form of the cathode and by the type and character and arrangement of the ligands in the equatorial plane. (tr-auth)

18363 CONTAMINATION CONTROL TRAINING COURSE. Meeks, R. J. Environ. Sci.; 17: No. 3, 11-19(1974).

A contamination control course was developed for employees of the General Electric Neutron Devices Department. A course outline of 15 lessons is presented and briefly described. Contaminant sources are tabulated and consist of atmosphere, clothing, industrial processes, people, plants, transportation, construction, alpha particles, beta particles, electrons, gamma rays, and neutrons. (HLW)

18364 APPLICATION OF THIN-LAYER GEL FILTRATION IN THE MICROANALYSIS OF RADIOIODINATED PROTEINS. Hruska, K. J.; Franek, M. (Veterinary Research Inst., Brno). J. Chromatogr.; 93: No. 2, 475-479(26 Jun 1974).

The application of thin-layer gel filtration on Sephadex in the analysis of radioiodinated proteins is described. The method permits the relatively rapid microanalysis of the iodination mixture as well as of radioiodinated proteins after removal of free radioactivity and indicates the presence of by-products in the iodination mixture on the basis of their different molecular weights. (LK)

18365 KINETIC BEHAVIOR OF THE ISOTOPIC EXCHANGE REACTION BETWEEN O-IODOBENZOIC ACID AND POTASSIUM IODIDE IN AQUEOUS SOLUTION. Chen, C. T.; Wu, M. C.; Yeh, S. J. (National Tsing Hua Univ., Hsinchu, Taiwan). Nucl. Sci. J. (Taiwan); 8: No. 3-4, 17-28(Dec 1971).

The isotopic exchange reaction between o-iodobenzoic acid (OIBA) and potassium iodide in aqueous solution has been studied at a temperature range from 78.4°C to 100°C. The concentration of o-iodobenzoic acid varied from 2.0×10^{-6} M to 1.0×10^{-3} M, while that of the iodide was fixed to 2.0×10^{-4} M. It was found that iodide separation caused by radiolytic decomposition of ^{131}I-OIBA may be arisen in the exchange reaction, therefore, the plot of log (1-F) vs. t is not a straight line which is required by the first-order exchange law. However, after a radical scavenger (diphenylpicrilhydrazil) is added, possible breakdown is stopped and the plot gives a straight line passing through the origin at zero time. The kinetic data show that the exchange reaction is first order with respect to the o-iodobenzoic acid concentrations. The activation energy was determined as 24,500 cal/mole. The kinetic data is consistent with the structural consideration on the reactants, and a bimolecular displacement mechanism for nucleophilic aromatic substitution may be suggested for the exchange reaction. (auth)

18366 THIN-LAYER CHROMATOGRAPHY OF ^{131}I-LABELLED RADIOPHARMACEUTICALS. Hsieh, T. H. (National Tsing Hua Univ., Hsinchu, Taiwan). Nucl. Sci. J. (Taiwan); 9: No. 1-2, 30-37(Jun 1972).

Usually ^{131}I-labeled radiopharmaceuticals such as ^{131}I-Rose Bengal, RISA, ^{131}I-MAA and ^{131}I-Hippuran may contain trace amounts of free radioactive iodide ion. For better quality control it is necessary to assay the free iodide in the radiopharmaceuticals. Paper chromatography has been widely used for this purpose. However, it usually takes about six hours to obtain the result, which is not suitable for the routine assay of short-lived radiopharmaceuticals. In this study thin-layer chromatography is developed for the analysis of radiopharmaceuticals mentioned above. It usually takes only about one hour to determine its purity. The procedure of this method is simple and reliable. This method is no doubt very suitable for rapid routine assay of ^{131}I-labeled radiopharmaceuticals. (auth)

18367 ACTIVITY RELEASE FROM TRITIUM-ACTIVATED LUMINESCENT MATERIALS. Guenther, E. (Physikalisch-Technische Bundesanstalt, Braunschweig, Ger.). Health Phys.; 27: No. 1, 139(Jul 1974).

A study has been made of tritium-activated luminophors [Gunther, Report PTB-FMRB-50 (in German)(1973)]. The observations reported there are summarized here. The specific activities of three fresh luminophors were determined several times in the course of about 2 yr and were found to decrease with an effective half-life of 2 yr. The release of tritium to air was studied over a period of 6 months which also indicated an effective half-life of 2 yr. It was found that tritium was mostly released in the form of tritiated water. By storing the luminescent materials in water it was found that they lost 3 to 4% of their activity to the surrounding water. Finally samples were put into a stream of demineralized water for about 10 days and their loss of activity noted with time. It is concluded that the observations may be interpreted as a consequence of a decomposition of the tritiated polymer—which surrounds the luminescent ZnS(Cu) grains as an activator—by the β-radiation of the tritium decay. (UK)

18368 SIMPLE SEPARATION OF IODIDE FROM RADIOIODINATED PROTEINS BY ION-EXCHANGE CHROMATOGRAPHY-CENTRIFUGATION. Franek, M.; Hruska, K. J. (Veterinary Research Inst., Brno). J. Chromatogr.; 93: No. 2, 471-474(26 Jun 1974).

An attempt to separate unreacted iodide from labelled proteins by means of centrifugation in combination with ion-exchange chromatography is described. (LK)

18369 CONSIDERATIONS IN THE RADIOLABELING OF ALBUMIN. Rhodes, B. A. (Johns Hopkins Medical Institutions, Baltimore). Semin. Nucl. Med.; 4: No. 3, 281-293(Jul 1974).

Labeled albumins for blood-pool, albumin metabolism, and gastrointestinal-blood-loss studies have been readily available for years, and their clinical use is well established. Labeled albumin for cisternography was once widely used; now it is restricted due to pyrogen contamination at levels too low to be detected by the official U. S. P. pyrogen test but still high enough to cause a significant incidence of aseptic meningitis when injected intrathecally. The more sensitive Limulus test for pyrogens may be used to overcome this problem. Labeled albumin for nuclear angiography and gated cardiac blood-pool studies is presently limited to ^{99m}Tc-albumin. Lack of a commercially available radiopharmaceutical for this purpose has been a limiting factor in the clinical application of these studies. Kits can be used to prepare ^{99m}Tc-albumin from ^{99m}Tc generator eluates, but they have not yet been perfected to the point where radiochemical contaminants are not a problem. Unbound pertechnetate and insoluble technetium cause unnecessary degradation of resolution and prolongation of the studies. This problem can be solved by daily quality-control testing of kit preparations or by the development of commercial sources of prelabeled and pretested ^{99m}Tc-human serum albumin. (auth)

18370 ROLE OF THE RADIOCHEMIST IN NUCLEAR MEDICINE. Subramanian, G. (Upstate Medical Center, Syracuse, NY). Semin. Nucl. Med.; 4: No. 3, 219-227(Jul 1974).

The radiochemist plays a vital role in nuclear medicine. He can be useful as a professional scientist providing radiodiagnostic agents for routine clinical use, and if called upon he can run the in vitro and radioimmunoassay laboratory. As a teacher, he can make substantial contributions in training physicians and technologists in nuclear medicine, and as a researcher he can be valuable in developing new radiodiagnostic agents while working in close collaboration with physicians. At present, there is a shortage of these trained scientists, and colleges of health-related professions in major medical centers should institute programs to train these vitally needed professionals. (auth)

18371 RADIOPHARMACEUTICAL QUALITY CONTROL. Stelmach, H. A.; Quinn, J. L. III. (Northwestern Univ., Chicago). Semin. Nucl. Med.; 4: No. 3, 295-303(Jul 1974).

Kits are currently available for the preparation of ^{99m}Tc-labeled compounds for scanning the lungs, liver, kidneys, and skeleton. Prior to administration of these radiopharmaceuticals to the patient, adequate quality control should be performed. The phenomenal growth in the diagnostic use of radiopharmaceuticals has shifted much of the manufacture and quality control to the individual nuclear medicine laboratory. This quality control encompasses chemical, biological, and radioactivity analysis. Considerations and test methods are detailed within this review. (auth)

18372 METHOD OF MAKING A URANIUM-ANTIMONY OXIDE CATALYST. Wise, K. V. (to Monsanto Company). US Patent 3,816,596. 11 Jun 1974. Filed date 4 Oct 1971. 10p.

An improved oxidation and/or ammoxidation catalyst based on antimony, uranium, and oxygen is prepared by forming a solution of solubilized antimony oxides and uranium salts or oxides, evaporating the solution to dryness to form a solid residue, drying the solid residue and heating the dried solid residue at a temperature of from 750 to 1000°C. A preferred embodiment produces a catalyst consisting essentially of a compound represented by the formula USb_3O_{10}. The catalyst is useful in oxidizing and ammoxidizing olefins. (Official Gazette)

18373 THERMOLUMINESCENCE STUDY OF STRUCTURAL TRANSITIONS IN FROZEN SULFURIC ACID AND OF THE THERMAL DEACTIVATION OF ELECTRONICALLY EXCITED UO_2^{2+} IONS. Korobeinikova, V. N.; Kazakov, V. P.; Chuvilin, Yu. N. (Inst. of Chemistry, Ufa, USSR). Dokl. Phys. Chem.; 213: No. 4-6, 1078-1079(Dec 1973).

Translated from Dokl. Akad. Nauk SSSR; 213: No. 4, 884-886 (Dec 1973).

In a thermoluminescence study of frozen sulfuric acid solutions of UO_2^{2+} in the temperature range from 77 to 300°K it was found that τ, the lifetime of the ion in an excited state, does not follow a smooth curve. This led to a detailed study of the variation of $I_p I$ (photoluminescence) and of UO_2^{2+} ions with temperature. No region was found which could be attributed to a purely thermal quenching action. The curves for both τ and $I_p I$ have maxima and inflections whose positions can be correlated with maxima in the thermoluminescence curves, i.e., with structural transitions. The data show that the dependence of the fluorescence intensity and the corresponding nonradiative deactivation of excited UO_2^{2+} on temperature in sulfuric acid solutions do not correspond to a single process for the activation of thermal quenching. Structural transitions occurring in the acid over different temperature ranges play a very significant, and sometimes predominant, part. (JSR)

18374 PREPARATION OF THE SPECIFICALLY LABELLED DEOXY SUGARS. Soukupova, V. (Inst. for Biological Research, Prague); Cerny, M.; Veres, K. Radiochem. Radioanal. Lett.; 18: No. 2, 107-116(15 Jul 1974).

A preparative method for synthesis of tritiated deoxy hexoses based on a catalytic hydrogenolysis of corresponding deoxy iododerivatives with gaseous tritium was worked out. Free 2-, 3-, 4- and 6-deoxy derivatives of D-glucose of high specific activity were prepared. Under similar conditions, deuterolysis was performed with 2- and 3-deoxy iododerivatives of D-glucose. NMR spectra of these compounds show that the course of dehalogenation depends on the overall structure of the original iododerivatives. (auth)

18375 POLAROGRAPHIC REDUCTION OF ZINC AND THORIUM IN FURFURYL MERCAPTAN MEDIA. Saxena, R. S.; Sheelwant, S. S. (Malaviya Regional Engineering Coll., Jaipur (India). Dept. of Chemistry). Z. Naturforsch., B.; 28: No. 7; 8, 429-432(Jul 1973).

6 figs.; 2 tabs. 9 refs.

The reduction of Zn and Th in furfuryl mercaptan was found to be irreversible and diffusion-controlled in 50% ethanolic media and 0.1 M $NaClO_4$. The values of kinetic parameters, transfer coefficient (α), formal rate constant ($K^0_{f,b}$), for the electrode reactions were determined by Koutecky's method as extended by Meites and Israel. The values of ΔH, ΔG, and ΔS are also reported. (auth)

18376 SYNTHESIS OF COMPLEX URANYL FLUORIDES WITH THE COMPOSITION $(NH_4)_2M^{II}(UO_2F_4)_2 \cdot 6h_2O$ AND THEIR PROPERTIES. Davidovich, R. L.; Peshkov, V. V.; Buslaev, Yu. A. (Inst. of General and Inorganic Chemistry, Moscow). Dokl. Chem.; 212: No. 4-6, 818-821(Oct 1973).

Translated from Dokl. Akad. Nauk SSSR; 212: No. 5, 1114-1117 (Oct 1973).

The synthesis and some of the properties of complexes of uranyl fluorides with the composition $(NH_4)_2M^{II}(UO_2F_4)_2 \cdot 6H_2O$, where M^{II} is Co, Ni, Cu, Zn, or Cd are described. For preparation of the complexes the UO_2F_2 was dissolved in water and $M^{II}F_2$ in 20 HF and NH_4F in water was added. The resulting solution was evaporated down to ½ the original volume and the salt crystallized. The compounds are colored crystalline substances, moderately soluble in water, and stable during storage in air. X-ray powder studies, IF spectra, and thermal stability studies were made. The thermal decomposition scheme was determined, and the decomposition temperatures of the compounds were tabulated. (JSR)

18377 STRUCTURE OF THE HYDRATE SHELL IN CRYSTALLINE HYDRATES OF URANYL TRICHLOROACETATE. Vdovenko, V. M.; Baluev, A. V.; Suglubova, I. G. (Leningrad State Univ.). Dokl. Chem.; 212: No. 4-6, 816-817(Oct 1973).

Translated from Dokl. Akad. Nauk SSSR; 212: No. 5, 1112-1113 (Oct 1973).

The structure of the hydrate shell of uranyl trichloroacetate trihydrate was studied by spectroscopic and thermogravimetric methods. The data showed that the trihydrate obtained by crystallization from solution had one water molecule in the outer sphere and two in the inner sphere. The reverse was true for the trihydrate obtained by hydration: two water molecules in the outer sphere and one in the inner sphere. The formulas for the two hydrates were determined and in the first case the uranyl coordination number is six whereas in the second it is five. (JSR)

18378 VAPOR PRESSURE AND COMPOSITION IN THE THERMAL DISSOCIATION OF AMERICIUM OXIDES. Ozhegov, P. I.; Myasoedov, B. F.; Zakharov, E. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Dokl. Chem.; 212: No. 4-6, 825-827(Oct 1973).

Translated from Dokl. Akad. Nauk SSSR; 212: No. 5, 1122-1124 (Oct 1973).

Equations describing the vapor pressure and composition in the thermal dissociation of AmO_2 into Am_2O_3 were derived. The dissociation parameters of the dioxide and sesquioxide were calculated and tabulated. (JSR)

Radioactive Waste Treatment

Refer also to abstract 20518.

18379 (ARH-SA-190) NEW RELATIONSHIPS FOR DESCRIBING DURABILITY MECHANISMS OF RADIOACTIVE WASTE SILICATES. Griffing, D. E.; Brownell, L. E.; Isaacson, R. E. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 1974. 20p. (CONF-740636-1). Dep. NTIS $4.00.

From meeting of the American Chemical Society; Cheney, Washington, USA (13 Jun 1974).

A theoretical model is presented, which is a close approximation to the durability-controlling mechanisms actually present in the radioactive waste solid. The analysis predicts the containment behavior of a solid in physical shapes and in environmental conditions unrelated to those of the leach experiment. The major facets of the leaching durability mechanism presented are diffusion, internal release, which is the mobilizing of sited ions so that they can diffuse, and dissolution of the solid at that surface. (MCG)

18380 (CONF-740406-20) EXPERIENCE AT THE NATIONAL REACTOR TESTING STATION IN SEGREGATION AND COMPACTION OF LOW-LEVEL SOLID WASTE. Passmore, R. W. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). [nd]. 17p. Dep. NTIS $4.00.

From second AEC pollution control conference; Albuquerque, New Mexico, USA (16 Apr 1974).

Aerojet Nuclear Company has initiated compaction of routine solid radioactive wastes. A description of the compaction and operational experience, including volume reduction ratios, are presented. (auth)

18381 (CONF-740434-4) HIGH-LEVEL WASTE SOLIDIFICATION: APPLICABILITY OF FLUIDIZED-BED CALCINATION TO COMMERCIAL WASTES. Dickey, B. R.; Wheeler, B. R.; Buckham, J. A. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs--Operations Office). 19 Apr 1974. Contract AT(10-1)-1375. 32p. Dep. NTIS $4.75.

From waste management symposium; Tucson, Arizona, USA (21 Apr 1974).

Plant-scale operations during the last ten years and pilot-plant studies have revealed no major problems with fluid-bed solidification. The basic process currently used at ICPP is applicable to commercial waste solidification. Process and equipment modifications necessary for commercial waste calcination are: (1) calciner vessel design for emergency bed dumping, (2) design compatible with total remote maintenance, (3) off-gas condensate for potential volatile ruthenium and NO_x removal, and (4) off-gas condensate cleanup. Calcined product is suitable for interim storage or for post-calcination treatment. (auth)

18382 (JPRS-62361) RADIOACTIVE WASTES, DECONTAMINATION, LOSSES OF URANIUM AND PLUTONIUM. Translated from At. Energ. (USSR); 36: No. 1, 27-37; 69-70(1974). 25p. NTIS.

The report contains three discussions of the use of sorption pulsation columns for decontaminating liquid radioactive wastes, methods of calculation and prediction of radioactive contamination of the ground layer of the atmosphere by discharges from pipes of atomic power plants, and losses of uranium and plutonium with steel during thermal opening of fuel elements. Two of the papers appeared previously in NSA as 30: 302 and 2839. A separate abstract was prepared for the third. (auth)

For abstracts of an individual paper see: 18398.

18383 (ORNL-1697) DEVELOPMENT OF THE AMEX PROCESS FOR AMERICIUM RECOVERY. Rainey, R. H. (Oak Ridge National Lab., Tenn. (USA)). 21 May 1954. Contract W-7405-eng-26. 34p. Dep. NTIS $4.75.

Declassified 3 Oct 1963.

The Amex process was developed for recovering americium from the accumulated Hanford slag and crucible waste. After the plutonium has been recovered by a 30% tributyl phosphate (TBP) extraction, the excess acid (5 M) in the aqueous waste is neutralized with calcium oxide or gaseous ammonia, and the americium is extracted with 30% TBP. The organic extract is scrubbed with ammonium nitrate, the americium is stripped with water, sorbed on Dowex 50W cation exchange resin, and eluted with ammonium acetate–acetic acid. Process losses are about 1%. An alternate process of simultaneous extraction of plutonium and americium with partition of americium showed promise but will not be used in this recovery for reasons stated. (auth)

18384 (Y-1950) PILOT PLANT NITRIC ACID RECOVERY BY DISTILLATION OF CONDENSATE WASTE. Laggis, E. G. (Oak Ridge Y-12 Plant, Tenn. (USA)). 30 Jul 1974. Contract W-7405-eng-26. 31p. Dep. NTIS $4.75.

A nitric acid distillation pilot plant was operated in support of a plant effort to recycle part of the nitrate effluents leaving the plant. Optimum operating conditions, distribution of chlorides and fluorides, effectiveness of a fluoride trap, and distillation performance were defined in test runs using anion-spiked nitric acid as a feed solution. The pilot plant was also operated continuously in a 15-day campaign to convert condensate waste from the uranium purification process to concentrated nitric acid. The impact of uranium, chloride, fluoride, and organic impurities in the waste on engineering design, operation, and recovered acid quality was evaluated from the derived pilot plant data supplemented with laboratory tests. Problem areas were revealed regarding feed impurities in the nitric acid product and organic reactions which had not occurred in all previous work using synthetic feed solutions. In addition to an evaluation of the nitric acid recovery performance, composition of the system output streams, and product quality, corrosion field tests were made for recommending materials of construction of a plant. (auth)

18385 STUDIES ON DINONYLNAPHTHALENE SULPHONIC ACID AS LIQUID ION EXCHANGER FOR RADIOACTIVE LIQUID WASTE DISPOSAL. I. Wang, S. M.; Chen, M. N.; Tseng, C. L.; Weng, P. S. (National Tsing Hua Univ., Taiwan). Radioisotopes (Tokyo); 22: No. 9, 492-496(Sep 1973).

A preliminary study on the treatment of radioactive liquid waste by dinonylnaphthalene sulfonic acid as liquid cation exchanger is given. Some fundamental studies on the selectivity coefficients and the gamma-radiation stability of dinonylnaphthalene sulfonic acid are presented and discussed. The selectivity coefficient is found to be the highest for the trivalent metal ions, and then the monovalent and the divalent metal ions in sequence; for the rare earth series the selectivity coefficient is decreasing with increasing atomic number. (auth)

18386 FLOTATION ISOLATION OF ^{106}Ru FROM AQUEOUS SOLUTIONS. Evtyukhova, O. E.; Nikiforov, A. F.; Berezyuk, V. G.; Pushkarev, V. V. Sov. Radiochem. (Engl. Transl.); 15: No. 4, 637-640(1973).

Translated from Radiokhimiya; 15: No. 4, 631-634(1973).

A study was made of the extraction of microamounts of ^{106}Ru, present in solution in the form of nitroso compounds, by ionic flotation using quaternary ammonium salts as collectors. Addition of the oxidants H_2O_2 and $KMnO_4$ to the solution increases the entrainment of ruthenium into the foam to 80 to 99%. The maximum extraction of the radioisotope under the optimal conditions occurs in the pH range of 6.0 to 9.0. On the basis of the experiments carried out the hypothesis was put forward that under the conditions studied the ruthenium is floated in the form of electrically neutral colloidal particles. (auth)

18387 HOW ION EXCHANGE CAN HELP REMOVE RAD-WASTE ROADBLOCKS TO NUCLEAR POWER. Olejar, L. L. Combustion; 45: No. 12, 39-43(Jun 1974).

Powdered ion exchange systems are being used successfully for the purification of radioactive waste solutions. In the Powdex process, extremely fine particle-size resins are used as a precoat on a cylindrical filter element contained within a pressure vessel. The fine resins provide 100 times greater available surface area than does the same weight of conventional resin, permitting a faster exchange rate. Advantages of the Powdex system are discussed. (JGB)

18388 HIGH RATE DEEP BED DEMINERALIZATION IS TODAY'S BEST SOLUTION TO NUCLEAR POWER. Crits, G. J. Combustion; 45: No. 12, 33-38(Jun 1974).

Recent developments in the use of deep bed mixed bed demineralization systems in the production of feedwater for nuclear steam units are discussed. A comparison is made of the cost and capability of various condensate polishing systems, including powdered resin filters, high rate hydrogen mixed beds, and high rate ammoniated mixed beds. Experience in the use of an ultrasonic resin cleaner and an alternate resin cleaning procedure called the Air Pump Rinse Operation is discussed. The Split Bed process (for BWR plants) allows for periodic resin cleaning via the ultrasonic or the ABRO process without disturbing the lower half of the main polishing resin bed. (JGB)

18389 RECOVERY OF USEFUL RESOURCES FROM NUCLEAR-FUEL REPROCESSING WASTES. Possibility of Obtaining Platinum Group Metal from Nuclear Reactors. Kobayashi, M. (Japan Atomic Energy Research Inst., Tokyo). Kogyo Rea Metaru; No. 51, 62-65(Feb 1973). (In Japanese).

With the rapid advance of nuclear power generation, the disposal of radioactive wastes from fuel reprocessing facilities becomes extremely important. This disposal must be made so as to minimize the amount of pollutants, and means are available for the recovery of useful resources. As such there are Ru, Rh, and Pd, metals of platinum group in spent fuel; these are produced in appreciable quantity from the fission of ^{235}U and ^{239}Pu. Of these, Rh and Pd are useful in industry, because of their surmountable radioactivity. Significance of the recovery of useful resources in the waste disposal is first explained. For the three elements, the respective radionuclides contained and the actual radioactivity in as-recovered state are described in detail, and also the hazard when the recovered metals are used in industry is explained. (JA)

18390 EVAPORATION OF ALPHA BEARING AQUEOUS WASTES IN LABORATORY SCALE. Akatsu, J., Ishimori, T. (Japan Atomic Energy Research Inst., Tokai). Radiochem. Radioanal. Lett.; 18: No. 2, 51-59(15 Jul 1974).

A simple evaporator is installed in a glove box. The ventilating air of the glove box always passes through the evaporator, in which various alkaline aqueous wastes are evaporated under electric heaters. The water vapor is carried off by the ventilating air, and discharged from the ventstack after having been filtrated. The residue in the evaporator is transferred to waste vessels and solidified with anhydrous gypsum. During 2 years, about 400 liters of the aqueous wastes were treated in the evaporating system and the present procedure was carried out safely without such troubles as explosion and α-radioactive contamination of the air released to the environment. (auth)

Radioisotope Production

Refer also to abstract 18371.

18391 ^{133m}Ba PRODUCTION AND A STUDY OF ITS APPLICATION TO BONE SCANNING. Levin, V. I.; Tarasov, N. F.; Kurtshatova, L. N.; Malinin, A. B.; Kurenkov, N. V.; Basura, N. A.; Arsentyeva, R. P. (Biophysical Inst., Moscow). Isotopenpraxis; 10: No. 5, 182-183(May 1974).

A procedure is worked out of ^{133m}Ba separation from proton irradiated cesium chloride. ^{133m}Ba was coprecipitated with calcium carbonate and the latter dissolved in hydrochloric acid and neutralized. More than 60% of the isotope is accumulated, in the skeleton of rats. Good scans of rabbit bones were obtained. (auth)

18392 CHEMISTRY OF TECHNETIUM 99m. Steigman, J.; Richards, P. (Downstate Medical Center, Brooklyn). Semin. Nucl. Med.; 4: No. 3, 269-279(Jul 1974).

The detection of a number of impurities in ^{99m}Tc effluents from ^{99}Mo generators is important for proper use of the generator systems. Their identification is described in this review. Technetium in sulfur colloid is probably present as Tc_2S_7. Reduction of the technetium by sodium thiosulfate (before acidification) will interfere with the preparation of this compound. In the labeling of serum albumin with ^{99m}Tc in a zirconium electrolytic cell, the pertechnetate is reduced by the zirconium. Successful serum albumin labeling procedures, with a variety of reducing agents, require acidification of the mixture of albumin and reduced technetium to about pH 2. This is believed to be associated with a number of reversible structural changes in the protein. Evidence for pertechnetate Tc in labeled serum albumin is not convincing. Experiments with ^{99m}Tc at the millimolar level suggest that stannous chloride in excess reduces pertechnetate in DTPA solution to the trivalent state and in citrate solution to the quadrivalent state. The reduced technetium is in the form of a dimer, probably with an oxygen or hydroxyl bridge between two Tc atoms, in renal scanning agents processed on the reduction of pertechnetate in the presence of mannitol or sodium gluconate or sodium glucoheptonate. Quality control of Tc radiopharmaceuticals is a difficult problem. Pitfalls in the use of a single technique such as anion-exchange resins or 85% methanol in paper chromatography are discussed in this review. (auth)

18393 RADIONUCLIDE GENERATOR SYSTEM. Lebowitz, E.; Richards, P. (Brookhaven National Lab., Upton, NY). Semin. Nucl. Med.; 4: No. 3, 257-268(Jul 1974).

High counting rates facilitate diagnosis in nuclear medicine with statistically more accurate information and less time-consuming procedures. Administration of the relatively large amounts of radioactivity required to achieve high counting rates is acceptable if short-lived nuclides are used to minimize the radiation dose to the patient. Sometimes a short biological half-life allows the use of large amounts of longer-lived nuclides, such as ^{133}Xe and ^{169}Yb-DTPA. To conveniently use a short-lived nuclide one must either be near its source of production or obtain it from a generator. The most desirable generators use a long-lived parent nuclide that continually produces by its radioactive decay a short-lived daughter nuclide. The daughter can be removed (milked) from the generator and the parent then generates a fresh

supply of the daughter. At equilibrium, both parent and daughter activities appear to decay with the half-life of the long-lived parent. This allows time for shipment of the generator, a shelf life that relates to the parent's half-life, and a continuing source of the daughter nuclide in the user's laboratory. In addition to improving the ratio of counting rate to radiation dose, short-lived radioisotopes also allow more frequent repetition of tests and a reduction of the problems associated with contamination and waste disposal. The generators of ^{99m}Tc, ^{113m}In, ^{81m}Kr, ^{82}Rb, ^{195m}Au, and ^{77m}Se are described. (auth)

18394 CYCLOTRON PRODUCTION OF RADIOACTIVE ISOTOPES FOR MEDICAL USE. Tilbury, R. S.; Laughlin, J. S. (Memorial Sloan-Kettering Cancer Center, New York). Semin. Nucl. Med.; 4: No. 3, 245-255(Jul 1974).

The cyclotron production of radioactive isotopes for medical use is a rapidly advancing area of medical science bringing together physicists, chemists, and physicians in an interdisciplinary field. The role of the cyclotron in medical research is increasing, and the production of labeled compounds with cyclotron-produced short-lived isotopes is increasing rapidly, although the utility of many of these compounds in nuclear medicine has yet to be established. This review is an attempt to place these developments in current perspective. (auth)

18395 NUCLEAR REACTOR AND ITS PRODUCTS. Poggenburg, J. K. (Oak Ridge National Lab., TN). Semin. Nucl. Med.; 4: No. 3, 229-243(Jul 1974).

The history of nuclear fission has been a rapid transition from theory to practical application as a weapon and, finally, to beneficial applications under controlled conditions in a fission reactor as a source of power and radioisotopes. The effective use of the enormous capacity of reactors to produce radioisotopes requires an understanding of the reaction cross sections and the influence of the neutron energy spectrum. Practical considerations include the selection of target compounds and isotopic enrichment to meet criteria for safety and product purity. Despite many natural limitations on what they can produce, reactors supply a large number of radionuclides important in nuclear medicine. (auth)

18396 QUALITY OF RADIOIODINE. David, G. S. (Scripps Clinic and Research Foundation, La Jolla, CA); Thomas, R. J. Science; 184: No. 4144, 1381(28 Jun 1974).

A higher ^{126}I content in carrier-free Na^{125}I led to poorer iodination of proteins. When a 100-fold excess of carrier KI was employed, the efficiency of incorporation returned to almost normal. (MCG)

Reactor Fuel Reprocessing

Refer also to abstracts 18233, 18477, 18480, 18790, and 18791.

18397 (AED-Conf-157-015) MONITORING OF THE RADIOACTIVE EFFLUENTS FROM THE EUROCHEMIC FUEL REPROCESSING PLANT. Gustafsson, D.; Osipenco, A. 1974. 11p. INIS.

From seminar on monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974).

3 tabs. With abstract.

The plant is briefly described and the main characteristics of the reprocessed fuel are given. The gaseous effluents are released via an 80-meter stack after filtration. The allowed releases are based on MPC's and a measured atmospheric diffusion factor. The sampling and monitoring system are described. Main results for yearly discharges are given. No liquid effluents are directly released. The low-level liquid wastes are transferred to the waste treatment installations of CEN/BelgoNucleaire via pipelines. Controls are performed in order to ensure that given contractual limits are observed. High-level liquid wastes are concentrated and stored on site. (auth)

18398 (JPRS-62361, pp 20-23) LOSSES OF URANIUM AND PLUTONIUM WITH STEEL DURING THERMAL OPENING OF FUEL ELEMENTS. Novoselov, G. N.; Dogaev, Yu. D.; Perevozchikov, S. A. Translated from At. Energ. (USSR); 36: No. 1, 69-70(1974).

The behavior of solid particles of UO_2 and PuO_2 in molten steel was calculated and the rate of time of settling was determined. The calculations confirm that the process of separating U and Pu from molten steel can be successfully accomplished in the steel drop itself because the continuous crucibleless process of opening the fuel elements by the thermal method can be accomplished during the time of formation of the steel drop. (JSR)

18399 METHOD OF DISSOLVING SPENT NUCLEAR FUEL. Ayers, A. L. (to Allied Chemical Corp.). US Patent 3,813,464. 28 May 1974. Filed date 28 Jun 1971. 10p.

A novel process for the dissolution of spent nuclear reactor fuel, while simultaneously controlling the amount of volatile off-gases evolved during the dissolution, comprises the steps of (a) passing spent nuclear reactor fuel, in regulated amounts, through a dissolvent solution, (b) continuously withdrawing the volatile off-gases which are evolved, (c) withdrawing a portion of the solution of spent nuclear reactor fuel when a predetermined maximum concentration of fuel values is reached in the solution, (d) adding a compensating volume of dissolvent solution while step (c) is being carried out, (e) continuously recirculating the remaining portion of the solution of spent nuclear reactor fuel to the dissolution step, (f) discontinuing steps (c) and (d) when a predetermined minimum concentration of fuel values is reached in the solution, and (g) repeating steps (c)-(f) as the predetermined maximum and minimum fuel values are repeatedly obtained in the solution. In a preferred mode of operation two dissolver systems are employed and fuel to be dissolved is fed to one dissolver system while the other dissolver system is being washed, discharged and readied for another dissolution cycle. (Official Gazette)

18400 THERMAL STRIPPING OF ZIRCONIUM-CLAD OXIDE-FUEL ELEMENTS. Ageenkov, A. T.; Bibikov, S. E.; Valuev, E. M.; Novoselov, G. P.; Savel'ev, V. F. At. Energ. (USSR); 35: No. 5, 323-325(Nov 1973). (In Russian).

To strip and separate fuel and structural materials, zirconium-clad oxide-fuel elements, were fused in a graphite crucible with Fe and Cu additions (10-20) at a temperature of 1050-1320°C in an inert atmosphere. Zr, Fe and Cu melts of high fluidity were separated from the fuel by decantation. The yield of zirconium in an ingot was 93-98% and the uranium content 0.1-0.23 wt. %. Uranium dioxide pellets separated from the melt disintegrated upon heating in air to 400-450°C, leaving a uranous-uranic oxide powder (1-10μ) and pieces of alloy (1-3 mm). The stripping of Zr-clad fuel-elements by fusing with Fe and Cu additions may be used as the leading operation in extraction, fluoride-gas and other processes of power-reactor fuel-reprocessing. (auth)

CONTROLLED THERMONUCLEAR RESEARCH

18401 TECHNOLOGY INDEX FOR PLASMA PHYSICS RESEARCH AND FUSION REACTORS. Volume 8, No. 6, 1974. Bibliography, author index, subject index, appendix. Leopoldshaften, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 40p.

18402 PLASMA PHYSIK-INDEX. Band 9, No. 6, 1974. Bibliographie, Verfasserregister, Sachregister. (Plasma Physics Index. Volume 9, No. 6, 1974. Bibliography, Author Index, Subject Index). Leopoldshafen; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 189p.

Confinement and Heating

18403 (IPPCZ-170) NONLINEAR DRAGGING OF PARTICLES AT HIGH-FREQUENCY HEATING. Klima, R. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Oct 1972. 18p.

The total longitudinal force acting on a high-frequency heated plasma column is derived for an arbitrary mecahnism of absorption. The force results from any violation of longitudinal symmetry (longitudinal plasma motion, one traveling wave, etc.). It effects particle drifts and poloidal fields relevant for plasma containment in a torus. The high-frequency power of the order of 10^5 W is sufficient to replace the driving electric field in a moderate-scale Tokamak device. (Nuclear Sci. Abstr. Czeck.)

18404 (IPPCZ-178) MICROWAVE HEATING OF ELECTRONS OF A DENSE PLASMA COLUMN AT FREQUENCIES HIGHER THAN ELECTRON CYCLOTRON FREQUENCY. II. Excited Electron Cyclotron Harmonic Waves and Their Resonant Wave-Wave Interaction. Datlov, J.; Klima, R.; Kryska, L. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu; AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). Jan 1973. 48p.

In an overdense collisionless plasma column inserted through the narrow sides of a rectangular waveguide, the excited electron cyclotron harmonic waves (CH waves) were studied using two movable probes and a phase interferometer in the range of parameters of $2 > \omega/\omega_{ce} < 1$; $0.5 < (\omega_{pe}/\omega)^2 < 15$. Two kinds of CH waves were found in the dipole mode, namely: a) stable backward CH waves with phase velocity in the direction from the axis to the periphery; b) unstable backward CH waves with phase velocity in the opposite direction. From the correlation measurements and amplitude distribution of the CH waves at the frequency applied and its second harmonic, an efficient nonlinear resonant interaction of CH waves was found to take place in the range of $2 > \omega/\omega_{ce} > 1.5$. The position of the loci of resonant interaction inside the plasma column was found both experimentally and by a new simple graphical procedure for the resonant conditions in the form of $\omega_2 = 2\omega_1$; $k_2 = 2|k_1|$. In the absence of this condition, no effective generation of the second harmonic frequency was found. The resonant interaction of CH waves at $\omega/\omega_{ce} = 1.85$ was found to be the reason for the self-trapping of CH waves between the zones of resonant interaction in the radial direction and for an anomalous heating rate of electrons. (Nuclear Sci. Abstr. Czeck.)

18405 (ORO-4210-1) rf SUPPLEMENTED MAGNETIC MIRRORS. Final Technical Report. Little, P. F. (Texas Univ., Austin (USA). Dept. of Physics). [nd]. Contract AT(40-1)-4210. 147p. Dep. NTIS $10.50.

The reflection of single ions of ~5 eV energy in combined rf electric and static magnetic fields was observed. The rf E-field was predominantly transverse to the magnetic field, and the rf potential distribution on axis was determined experimentally. Computed values were found to agree with those measured on the axis, and thus the whole volume distribution of the rf potential was computed for the geometry in use. The experiments showed that transmission or nonadiabatic reflection occurred for all ions (including those moving along B_0 field lines) for certain ranges of parameters. Orbit calculations for many ions all agreed with observation except when the numerical method was known to be inaccurate. Adiabatic reflection was predicted to occur outside the range of the experimental parameters available. It was necessary that $\omega \approx \Omega_1$ for ions to be reflected at all. The computer program was also compared with an analytic treatment already available, and found to be in agreement with this for specific cases. (MOW)

18406 (SLA-74-5226A) TECHNOLOGY OF ELECTRON BEAM INDUCED FUSION. Chang, J.; Clauser, M. J.; Freeman, J. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 15p. (CONF-740630-4). Dep. NTIS $4.00.

From 8th symposium on fusion technology; Noordwijkerhout, Netherlands (17 Jun 1974).

The use of tightly focused relativistic electron beams is considered as an alternative to lasers as a means of heating and compressing matter for achieving fusion. The potential attractiveness of the approach stems from the demonstrated high efficiency of relativistic beam machines, and the ability to scale the present pulsed power technology to deliver a 10^{13} W, 10^5 J beam onto a spherical target. The potential of this approach to achieving fusion is discussed, along with several of the questions still remaining to be answered. In particular, the problems involved in a reactor design using this technique is examined, including the associated problems of material damage, energy conversion, and average power output. (auth)

18407 PROPAGATION OF LASER RADIATION THROUGH A LONG PLASMA COLUMN. Humphries, S. (Los Alamos Scientific Lab., NM). Plasma Phys.; 16: No. 7, 623-634(Jul 1974).

Calculations are presented on the propagation of laser radiation parallel to the magnetic field in a pinch plasma column in reference to recent proposals for plasma heating. It is shown that waveguide type modes with no longitudinal dependence may be necessary because of radiation pressure considerations. The size of these modes is calculated self-consistently assuming classical plasma transport coefficients and inverse Bremsstrahlung absorption. In all cases of interest, the area occupied by the laser radiation is small compared to the cross sectional area of the plasma. The solutions are stable against self-focusing but unstable to a firehose instability at high radiation densities. From this viewpoint, a system in which the radiation can make many passes through the plasma is worse than a single pass system. (auth)

18408 RADIAL PROFILE OF ALPHA-PARTICLE HEATING IN A TOKAMAK. Stringer, T. E. (UKAEA Research Group, Abingdon). Plasma Phys.; 16: No. 7, 651-659(Jul 1974).

An appreciable fraction of the α-particles produced by fusion in next generation Tokamaks or in a reactor, will be trapped in the toroidal magnetic field. The radial excursion of their orbits will exceed the width of the production profile. The broadening effect of finite orbit size on the profile of α-particle density, and hence of the energy transferred to the thermal plasma, is evaluated. Existing orbit analysis is not valid in the conditions of interest ($\epsilon^{\frac{1}{2}}\rho_\theta > r$, where ρ_θ is the Larmor radius in the poloidal field) and the orbit characteristics must first be derived. The maximum orbit width is found to be $1.64\ R(2q\ \rho/R)^{\frac{1}{2}}$, instead of $\epsilon^{\frac{1}{2}}\rho_\theta$ as predicted by the small ρ_θ analysis. The broadening of the α-heating profile will have a modest effect on the temperature distribution. (auth)

18409 OPTIMAL CONFINEMENT OF COLLISIONLESS PLASMAS BY LOCALIZED TIME-VARYING ELECTRIC FIELDS. Wang, P. K. C. (Univ. of California, Los Angeles). Int. J. Contr.; 19: 449-472(Mar 1974).

The problem of optimal confinement of collisionless plasmas by means of external amplitude-limited time-varying electric fields localized to an outer layer enclosing the confinement region (a specified closed bounded spatial domain) is considered. The plasma equations are formally developed, and the existence and uniqueness of solutions of the plasma equations are established. This is followed by the formulation of the optimal confinement problem along with a discussion of the existence of an optimal electric field (control). By introducing additional assumptions to simplify the problem, sub-optimal feedback controls are obtained. The effectiveness of the derived feedback controls is determined numerically using a computer-simulated plasma. (IAA)

18410 PLASMA HEATING BY EXCITING THE SPECTRUM OF MAGNETOSONIC OSCILLATIONS OF A PLASMA COLUMN IN TOKAMAK TO-1. Ivanov, N. V.; Kovan, I. A.; Siluyanov, V. V.; Shvindt, N. N. At. Energ. (USSR); 36: No. 5, 375-377(May 1974). (In Russian).

Experiments in magnetosonic plasma heating in Tokamak TO-1 at an rf power level comparable to that of ohmic heating are described. A significant increase in the ion temperature and energy content of the plasma was observed, rf heating was accompanied by an outward displacement of the plasma column, a decrease in its internal inductance and an increase in the current of plasma equilibrium regulators. (auth)

18411 RADIATION TEMPERATURE PROFILES IN AN rf PLASMA OVER A WIDE RANGE OF APPLIED MAGNETIC FLUX INTENSITIES: THEORY AND EXPERIMENT. Thompson, S. D. Atlanta; Georgia Inst. of Tech. (1974). 142p. University Microfilms Order No. 74-16,141.

Thesis (Ph. D.).

Measurements of the temperature profiles in an rf argon plasma were made over magnetic field intensities ranging from 20 amp turns/cm to 80 amp turns/cm. The results were compared with a one-dimensional numerical treatment of the governing equations and with an approximate closed form analytical solution that neglected radiation losses. The average measured temperatures in the plasma compared well with the numerical treatment, though the experimental profile showed less of an off center temperature peak than predicted by theory. This may be a result of the complex turbulent flow pattern present in the experimental torch and not modeled in the numerical treatment. The radiation term cannot be neglected for argon at the power levels investigated. The closed form analytical approximation that neglected radiation led to temperature predictions on the order of 1000°K to 2000°K higher than measured or predicted by the numerical treatment which considered radiation losses. The governing equations are highly coupled to the electrical conductivity of the working fluid. An aerosol of submicron tungsten particles was added to the argon to effect a significant increase in the electron number density and temperature measurements were taken and compared with the theory. The temperatures were of the order of 1000°K lower than for the cases of pure argon, and compared well with the theory at tungsten partial pressures of 4.3×10^{-3} atm and 6.1×10^{-3} atm. A tungsten partial pressure of 3.6×10^{-3} atm led to a divergence between the theory and the experiment as the tungsten atom number density reached the point that electron-tungsten collisions could no longer be neglected in the theoretical treatment of the electrical conductivity. A parametric study was conducted to determine the effect of variations in the inputs to the analysis which can be varied experimentally, and to determine the effect that the uncertainty in the transport properties of argon has on the predicted temperature profiles. (Diss. Abstr. Int., B)

18412 ANALYSES OF TWO NONNEUTRAL PLASMA EQUILIBRIA: MEASUREMENT OF THE TRAPPED ELECTRON ENERGY DISTRIBUTION. Hornady, R. S. College Park, MD; University of Maryland (1973). 184p. University Microfilms Order No. 74-16,565.

Thesis (Ph. D.).

A magnetically trapped electron distribution with relativistic velocities was studied theoretically and experimentally. The theoretical study is of two plasma models; the experimental section describes the measurement of the energy distribution of electrons trapped in a magnetic mirror. The two plasma models are based on a relativistic rigid rotor and on the constancy of canonical angular momentum. The equations of motion for an electron are solved and the electric and diamagnetic fields calculated. When the response of the plasma to changing an external magnetic field is studied, it is found that the rigid rotor diamagnetic ratio is fixed and the constant canonical angular momentum diamagnetic ratio has a maximum determined by the number of particles. In the calculation of the spectrum of synchrotron radiation from both models, neither model reproduces the experimentally measured spectrum; it is concluded that neither can represent the electrons confined in the magnetic mirror. The energy distribution of the electrons trapped by the magnetic mirror is measured with a thin-window scintillation detector. When the midplane magnetic field is 15.5 kg, an approximately normal distribution of 1.4×10^{12} electrons with a mean energy of ~1.3 MeV and a standard deviation of 0.27 MeV is trapped. The distribution is calculated from the pulse height spectrum of electrons scattered along field lines. Small bursts of electrons, both axial and radial, are observed. (Diss. abstr. Int., B)

Diagnostics

18413 (UCID-16497) CHARACTERISTICS OF THE OPTICAL MULTICHANNEL ANALYZER AS A SPECTROSCOPIC DETECTOR. Saroyan, R. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 May 1974. Contract W-7405-eng-48. 36p. Dep. NTIS $5.00.

Data and experiences gathered from using the SSRI Optical Multichannel Analyzer as a spectroscopic detector are presented. Model 1205B is discussed and compared to Model 1205F. Operating hints for the system and examples of its use in spectroscopy are given. This paper is an informal supplement to the SSRI manual, which is oriented toward the computer characteristics of the analyzer rather than the detector characteristics. (auth)

18414 CHARACTERISTICS OF A METHOD FOR THE DETERMINATION OF THE ELECTRON CONCENTRATION BY INTENSITY OF FORBIDDEN TRANSITIONS IN LITHIUM PLASMA. Mikhlev, V. G.; Ogorodnikov, S. N.; Pankratov, V. G. Zh. Prikl. Spektrosk.; 20: No. 5, 889-891(May 1974). (In Russian).

The problem of the determination of the electron concentration by forbidden transitions is examined. The results obtained by this method were compared with the determination of electron concentration by H_β broadening. (tr-auth)

18415 CO_2 LASER BEAM REFRACTION IN A LINEAR DISCHARGE PLASMA. Molen, G. M.; Kristiansen, M.; Hagler, M. O. (Texas Tech. Univ., Lubbock). Appl. Phys. Lett.; 23: No. 11, 601-603(1 Dec 1973).

Beam guiding and focusing were observed for CO_2 laser propagation in a high-density low-temperature annular plasma. A TEA laser was fired along the axis of a cylindrical plasma column of densities in the 10^{16}–10^{17}-cm^{-3} range. Several radial density profiles were investigated. Beam guiding and focusing were observed when the density has a minimum on the axis. A density maximum on-axis refracted the beam toward the tube walls, and intense "hot spots" resulting from apparent filamentation inside the plasma were recorded. (auth)

18416 PHASE SHIFT MEASUREMENT OF MICROWAVE INTERFEROMETER FOR PLASMA DIAGNOSTICS. Kuwahara, C.; Matsuura, K.; Miyahara, A. (Nagoya Univ., Japan). Jap. J. Appl. Phys.; 13: No. 2, 318-326(Feb 1974).

Phase shift measurements with a microwave interferometer were analyzed to estimate the error in the measurement caused by mismatchings and unbalances of microwave elements in the detection system. When the most reasonable adjustments are made to balance the phase sensitive detection system, the error $\Delta\theta$ is estimated to be proportional to the degree of mismatch and unbalance γ, the intensity ratio of a transmitted wave to a reference wave ξ and the ratio of the wave attenuation through the plasma $1-\alpha$ and is given as $\Delta\theta = \frac{1}{4}\gamma\xi(1-\alpha)$. This relation was confirmed with simlation experiments. In an usual case where $\gamma \lesssim 0.4$ and $\xi = 0.3$, the error is about 0.05 radians, if the transmitted wave is attenuated to one tenth due to the presence of a plasma. (auth)

18417 MEASUREMENTS OF PLASMA DENSITY DISTRIBUTION AND CURRENT-SHEATH STRUCTURE IN THE IMPLOSION PHASE OF A THETA-PINCH DISCHARGE. McKenna, K. F.; Kristal, R.; Thomas, K. S. (Los Alamos Scientific Lab., NM). Phys. Rev. Lett.; 32: No. 8, 409-412(25 Feb 1974).

The spatial and temporal evolution of the plasma density distribution and its relation to the magnetic-piston-field structure during a theta-pinch implosion were experimentally investigated. With a deuterium fill density of 0.7×10^{15} atoms cm^{-3}, evidence of particle reflections from the imploding piston field is indicated. (auth)

18418 IMPROVED CONSTRUCTION OF ROGOWSKI COILS FOR MEASUREMENT OF PLASMA CURRENTS. Honea, D.; Medley, S. S. (Univ. of Texas, Austin). J. Phys., E (London); 7: No. 7, 537-538(Jul 1974).

A method of constructing Rogowski coils is described which eliminates coil failure due to insulation faults. (auth)

18419 STUDY OF THETA-PINCH PLASMA USING A MACH–ZEHNDER INTERFEROMETER ILLUMINATED BY A GIANT PULSED RUBY LASER. Wu Li Hsueh Pao; 23: No. 1, 1-16(24 Jan 1974). (In Chinese).

The plasma electron density, shape and instability of the 23 kJ θ-pinch were studied through the use of a Mach–Zehnder interferometer with giant pulsed ruby laser illumination. The axial interferograms in the range of 45 to 120 m torr deuterium pressures gave two-dimensional electron density distributions for the discharge and established peak plasma electron densities in the range of 6×10^{16} to 2.3×10^{17} cm^{-3} for the plasma at peak pinch. The time of the peak pinch was about $\frac{1}{3}$ of the first half cycle of the main compressive magnetic field. The plasma characteristic time of containment (the time required for the number of particles to be reduced to 1/e) close to peak pinch was 1.8 to 4.3 μs. The interferograms with reverse bias magnetic field showed that the bias magnetic field was trapped in the plasma, and revealed that radial hydromagnetic oscillation of the plasma occurred between the trapped magnetic field and the main compressive magnetic field. The interferograms also showed that the plasma is essentially stable during the first half-cycle of the main compressive magnetic field in the range of 45 to 80 m torr deuterium pressures. (JPRS)

18420 MICROWAVE STUDIES OF MAGNETICALLY INDUCED MOMENTUM COUPLING IN LASER PRODUCED PLASMAS. Cheung, A. Y. College Park, MD; University of Maryland(1973). 96p. University Microfilms Order No. 74-12,817.

Thesis (Ph. D.).

The effect of a magnetic field on momentum coupling interactions between counterstreaming plasmas was studied by allowing a laser-produced copper plasma to expand into photoionized low-pressure background of heavy gases (argon and xenon) in the presence of a 700 Gauss transverse magnetic field. The choice

of argon and xenon is based on theoretical results which indicate that conditions with copper plasma expanding into such gases at a velocity of 10^7 cm/sec are free from collisional interferences. Experimental measurements were made with electrical diagnostics at radii on the order of 10 cm away from the point of plasma production. At such radii, diagnostics capable of spatial and temporal resolution on the order of 0.5 cm and 50 nanoseconds are required. A single wire microwave interferometer system, capable of giving better than 0.5 cm and 50 nanoseconds spatial and temporal resolutions at x-band frequencies ($f \sim 8-12$ GHz) was built and calibrated from electron density measurements. Langmuir probes, which can be operated either in low impedance (current) or high impedance (voltage) modes were also used as supplementary diagnostics. Experiments were performed with a flowing laser copper plasma ($U \sim 10^7$ cm/sec) expanding into various amounts of photoionized background argon and xenon with and without the 700 Gauss magnetic field. Free interpenetration between the laser plasma and the background occurred without the magnetic field. Turbulent interactions as well as a second density maximum representing momentum coupling were observed in the presence of the magnetic field and the second density feature decelerates according to the predictions of conserved-momentum coupling models. Such observations indicate that a collisionless momentum coupling mechanism has been induced by the 700 Gauss transverse magnetic field. Theoretical treatments of magnetized two-stream instabilities suggest that a modified two stream instability may occur in the experimental regime with coupling length scales consistent with the experimental dimensions. (Diss. Abstr. Int., B)

18421 CYLINDRICAL PROBE IN A COLLISION DOMINATED PLASMA WITH A UNIFORM MAGNETIC FIELD. Sharma, V.; Verma, J. S. (Birla Inst. of Tech. and Science, Pilani, India). J. Inst. Telecommun. Eng.; 19: No. 6, 291-295(Jun 1973).

Langmuir probe theory for a slightly ionized, collisional plasma is extended to a problem formulation to allow for the presence of uniform magnetic field. Plasma potential and density distributions were studied to the cylindrical probe whose axis is aligned with the direction of the magnetic field. The saturation current for the negatively biased probe was calculated. The derivation of the mathematical formulation is based upon the technique of taking the conservation of mass to the number flux equations for diffusion with electric and superposed magnetic field solved with the help of Poisson's equation for sheath and quasi-neutral regions. (auth)

Kinetics (General)

18422 FAST-WAVE INTERACTION WITH A RELATIVISTIC ELECTRON BEAM. Sprangle, P. (Cornell Univ., Ithaca, NY). J. Plasma Phys.; 11: No. 2, 299-309(Apr 1974).

The excitation of a relativistic electron beam, by means of a fast waveguide structure, is examined. Here the beam is injected into a modified waveguide, and interacts with the modes of the guide in such a way as to transform some of its energy into microwave radiation. This microwave generation device, called the Ubitron, is based upon a fast-wave excitation of a magnetically modulated relativistic electron beam. The beam is modulated by injecting it into a small spatially periodic magnetic field region within the guide. Analysis of this interaction shows that the slow space charge beam mode couples actively to the fast transverse electric guide mode. The result is parametric instability of the coupled modes. Synchronism between the doppler-shifted transverse travelling wave and the undulating electron beam results in a transfer of energy from the beam to the transverse field. The parametrically growing field can be a source of microwave radiation. The period magnetic field, together with the beam density, provide the coupling media between the unstable waves. The growth rate of the instability is shown to depend, in a nonlinear manner, on the product of the beam plasma frequency and the strength of the applied rippled magnetic field. The growth rate is obtained as a function of the system parameters. (auth)

18423 ACCELERATION OF POWDER PARTICLES BY GAS-DISCHARGE PLASMA AND THEIR INTERACTION WITH SOLIDS. Lazarenko, B. R.; Gitlevich, A. E.; Tkachenko, V. N.; Fursov, S. P. Elektron. Obrab. Mater.; No. 5, 31-33(1973). (In Russian).

The results of the measurement of the velocity of metallic powder particles, accelerated by a gas-discharge plasma, produced by a strong spark discharge, were reported. Some characteristics of the interaction of the high-velocity flow of plasma, liquid, and vapor phase of metals with the solid subbase were reported. (tr-auth)

18424 STUDIES ON PLASMA ANODIZATION IN A DC GLOW DISCHARGE. Graham, O. Vancouver, Canada; University of British Columbia (1973). National Library of Canada, Ottawa. Thesis (Ph. D.).

The phenomenon of anodization in the plasma of a dc low pressure oxygen glow discharge was investigated, both from the viewpoint of the mechanisms involved and for potential applications. Aspects studied include the effect of discharge conditions on anodization rate, the significance of negative oxygen ions in the plasma, the ionic current-field strength relation in the oxide, and the anodization of metal films on silicon for MIS devices. It was found that the process does not utilize gaseous negative ions from the neutral plasma, and that species transport through the oxide is by high field ionic conduction. The variation of anodization rate with discharge conditions was attributed principally to a dependence of the oxide field strength on the electron energy distribution and density in the plasma. Double oxide layer MIS structures were fabricated, and charge storage effects were investigated. (Diss. Abstr. Int., B)

18425 TOROIDAL DRIFT OF A COLLISIONLESS PLASMA. Eijima, S. Columbia, NY; Columbia University (1973). 101p. University Microfilms Order No. 74-12,705.

Thesis (Ph. D.).

The toroidal drift of a collisionless plasma flowing along a curved magnetic field was directly observed. The experiment was done using a low density plasma generated in a small single-ended Q-machine. The magnetic field lines were bent into an arc of a circle with curvature adjustable by additional magnetic windings, designed for smooth line curvature with the aid of a stereoscopic computer-graphics device; the magnetic geometry was also determined by a weak electron beam. The polarization field in the plasma was short-circuited by the presence of the hot ionizer which terminated the other end of the plasma. The toroidal drift was observed experimentally by a movable battery of 45 probe wires mounted in an insulator which terminated the plasma. The plasma potential and plasma density were measured with this and displayed quantitatively using a fast analog-digital data printer. The experimental data correlated satisfactorily with a two-fluid theory in which the curvature drift was modelled by an effective gravitational force. (Diss. Abstr. Int., B)

Kinetics (Experimental)

18426 DEPENDENCE OF THE RF CONDUCTIVITY OF A LOW TEMPERATURE GAS DISCHARGE AIR PLASMA ON THE RF FREQUENCY. Chiplonkar, V. T.; Acharekar, M. A. (Inst. of Science, Bombay). J. Univ. Bombay; 39: No. 66, 25-33(1970).

The rf electrical conductivity (real part) of a low temperature, air plasma was shown to have a maximum value for $f \approx 13$ MHz and $p \approx 45$ to 55 μ. In terms of a simple model this was interpreted to show that the electron volume density, and collision frequency both show significant variation with the frequency of the rf signal. This conclusion was confirmed by supplementary observation on the longitudinal dc electric field in the plasma and on μ_e, the electron mobility, as a function of the rf frequency. (Indian Sci. Abstr.)

18427 MAGNETICALLY STABILIZED HELIUM ARC FOR SCATTERING EXPERIMENTS. Potocnik, V. Vancouver, Canada; Univ. of British Columbia (1973). National Library of Canada, Ottawa.

Thesis (Ph. D.).

For verifying some theoretical predictions of light scattering from magnetized plasmas, a stable pulsed helium arc discharge in a magnetic field up to 5 Teslas was built. The arc was investigated at filling pressures of 2 to 5 torr and plasma currents between 1 and 5 kA. Plasma parameters were measured at a magnetic field of 4 Teslas and a pressure of 3 torr. At these values of the magnetic field and the filling pressure the arc is steady and approximately cylindrically symmetric up to a plasma current of 2.8 kA. Time dependence and radial distribution of the electron density and temperature have been determined from spectroscopic measurements, laser interferometry and laser scattering. The latter two techniques were used successfully for the first time on a magnetically stabilized arc to measure the electron density and temperature in the hot core of the arc. The axial electron density is 1.2×10^{16} cm^{-3} and is approximately constant over the arc cross-section in the high temperature region as predicted by theory. The axial temperature is 145,000°K. Thus the arc design and the plasma properties are suitable for scattering experiments. The arc behavior is governed by dynamic processes which depend on the geometry of the apparatus. In order to show the problems of the design and operation of the apparatus, the theory of arc behavior in a magnetic field is outlined. (Diss. Abstr. Int., B)

Kinetics (Theoretical)

Refer also to abstract 20255.

18428 (AD-753104) COMPUTER SIMULATED, NONLINEAR IMPULSE RESPONSE OF INHOMOGENEOUS PLASMA SLAB. Technical Report. Brooks, J. N.; Cheo, B. R. (New York Univ., Bronx, N. Y. (USA). Dept. of Electrical Engineering and Computer Science). Oct 1972. 123p. (AFOSOR-TR-72-2377). NTIS $3.00.

The response of an inhomogeneous plasma to strong, initial impulse electric field excitation was studied by means of a sheet model computer simulation. Runs were made for both cold and warm plasmas having a cosine like density background. Strong nonlinear effects are observed, as well as phenomena distinctly attributable to the inhomogeneity. These include a nonmonotonic voltage decay rate, complex mode structure of the electric fields, and strong density peaks. An increase in thermalization occurs in all cases. (auth)

18429 KINETIC EQUATIONS FOR PLASMAS SUBJECTED TO A STRONG TIME-DEPENDENT EXTERNAL FIELD. Pt. 1. General Theory. Balescu, R.; Misguich, J. H. (Univ., Brussels). J. Plasma Phys.; 11: No. 3, 357-375(Jun 1974).

It is shown that the concept of subdynamics introduced by Prigogine et al. (Physica; 45: 418(1969)) and extended by Balescu et al., (Physica; 54: 477(1971)), can be generalized nontrivially to systems submitted to time-dependent external fields. The distribution vector of the system is split into two components by means of a time-dependent projection operator. Each of these obeys an independent equation of evolution. The description of the evolution of one of these components (the superkinetic component) can be reduced to a kinetic equation for a one-particle distribution function. It is shown that, when the external field vanishes for all times $t \leq t_0$, and if the system has reached a (field-free) equilibrium (or a "kinetic state") at time t_0, then for $t \geq t_0$ the kinetic equation derived here provides an exact and complete description of the evolution. A general expression for the nonlinear response of the system to the external field is derived. (auth)

18430 KINETIC EQUATIONS FOR PLASMAS SUBJECTED TO A STRONG TIME-DEPENDENT EXTERNAL FIELD. Pt. 2. The Weak-Interaction Approximation. Balescu, R.; Misguich, J. H. (Univ., Brussels). J. Plasma Phys.; 11: No. 3, 377-387(Jun 1974).

The general theory developed in part 1 (Balescu et al., J. Plasma Phys.; 11: 357(1974)) is illustrated for a plasma described by the weak-coupling (Landau) approximation. The kinetic equation, valid for arbitrarily strong external fields, is written out explicitly. (auth)

18431 MOTION OF A CHARGED PARTICLE IN ELECTROSTATIC AND ELECTROMAGNETIC FIELDS. Stewart, P.; Standeven, H. R. (Manchester Univ., England). Plasma Phys.; 16: No. 7, 661-667(Jul 1974).

Exact solutions are given of the relativistic nonlinear equations of motion for both the momentum and displacement of a charged particle which is injected with given momentum into an arbitrary number of intense electro-magnetic waves of any polarization and frequency (including zero) which propagate along a uniform electrostatic field with the speed of light. (auth)

18432 KORTEWEG-DE VRIES EQUATION FOR A TWO COMPONENT PLASMA. Tran, M. Q.; Hirt, P. J. (Centre de Recherches en Physique, Lausanne, Switzerland). Plasma Phys.; 16: No. 7, 617-621(Jul 1974).

A Kortweg-de Vries equation for a two component-plasma with cold ions ($T_i = 0$ for both species) and isothermal electrons is derived. The amplitude of the solitons is reduced drastically by a few percent of light ions and an initial perturbation breaks up into more solitons than in a one component plasma. (auth)

18433 ELECTRON TEMPERATURE RESONANCE OF A PLASMA COLUMN DESCRIBED TO FULL FIRST ORDER IN THE TEMPERATURE. Koch, R.; Vandenplas, P. E. (Ecole Royale Militaire, Brussels). J. Plasma Phys.; 11: No. 3, 451-460(Jun 1974).

An inhomogeneous plasma column surrounded by a glass wall is described through full first order in temperatures T_e and T_i, using a complete electromagnetic treatment. The response is studied of this system to a purely TE wave with $\bar{k}$ perpendicular to the axis. Comparison with existing theories and experimental results is made in the electron-wave domain (ions play no role) with zero steady magnetic field, i.e., in the case of temperature (Tonks-Dattner) resonances. Perhaps surprising at first sight, there is poor agreement with experiment at low density, the classic T_e^1 theory (scalar perturbed pressure approximation) giving far better results. Simple arguments concerning the different levels of approximation in the description of the longitudinal k^2 make it possible to distinguish the crucial difference existing between a scalar pressure and a complete T_e^1 description and to understand this result. These findings are generalized, demonstrating that a $T_e^{n-\frac{1}{2}}$ description is always more realistic than a T_e^n one in the range $\omega_{pe} < \omega$. (auth)

18434 MAGNETOPLASMA EQUILIBRIA WITH GEOMETRY OF DOUBLE-INVERSE-PINCH. Yeh, T. (National Center for Atmospheric Research, Boulder, CO). J. Plasma Phys.; 11: No. 3, 423-433(Jun 1974).

Equilibrium solutions, which represent configurations of a magnetoplasma with the geometry of double-inverse-pinch, are presented. (auth)

18435 FIELD LINE RECONNECTION AND MAGNETIC ENERGY RELEASE. Yeh, T. (National Center for Atmospheric Research, Boulder, CO). J. Plasma Phys.; 11: No. 3, 411-422(Jun 1974).

It is shown that an equilibrium of a magnetoplasma with a small separatrix angle at the magnetic neutral point possesses a greater magnetic energy than its corresponding equilibrium with a large separatrix angle. Hence, it is energetically possible for a configuration with two oppositely directed magnetic fields in contact to proceed to a potential field through the process of field line reconnection. The excessive magnetic energy would be released into kinetic and thermal energies. (auth)

18436 DIELECTRIC FUNCTION AND DIFFUSION OF A GUIDING-CENTER PLASMA. Taylor, J. B. (Inst. for Advanced Studies, Princeton, NJ). Phys. Rev. Lett.; 32: No. 5, 199-202 (4 Feb 1974).

The dielectric function for the two-dimensional guiding-center plasma is discussed. An error is noted in a calculation based on the Vlasov equation by Lee and Liu and an improved derivation is given using the Kubo formalism. Although this new dielectric function embodies the correct screening effect, it does not (contrary to earlier suggestions) essentially change the Taylor-McNamara result for the diffusion coefficient. (auth)

18437 PARTICLE CORRELATIONS IN A CLASSICAL ONE-COMPONENT PLASMA. Abramo, M. C. (Centre de Calcul Atomique et Moleculaire, Orsay, France); Tosi, M. P. Nuovo Cim.; 21B: No. 363-375(11 Jun 1974).

The equilibrium and dynamic properties of a classical one-component plasma are investigated by a self-consistent approach over the range of values of the plasma parameter to which liquid-structure theories are usually applied. The theory is explicitly shown to eliminate the Debye-Hückel-like divergence in the pair correlation function, to closely satisfy thermodynamic consistency as embodied in the compressibility sum rule, and to be in reasonably accurate agreement with Monte Carlo data on the structure and the thermodynamic properties of the plasma. The calculation of the dynamic structure factor shows a flattening of the dispersion of the plasmon excitation with increasing values of the plasma parameter and a prominent damping at finite wave vectors by decay into single-particle excitations. It is argued that these features will lead to a negative dispersion and to a sharpening of the plasmon for values of the plasma parameter larger than about ten. (auth)

18438 LANGRANGIAN METHODS IN PLASMAS DYNAMICS. Pt. 2. Construction of Langrangians for Plasma. Dougherty, J. P. (Cambridge Univ., Eng.). J. Plasma Phys.; 11: No. 2, 331-346(Apr 1974).

The construction of suitable Lagrangian functions for the dynamics of a cold plasma in such a way as to retain the relativistically covariant formalism is discussed. In one method, this is achieved by the introduction of a set of three variables which label the world lines of the particles. A second method results in a Clebsch type of representation. Sturrock's (Sturrock, P. A. 1958 Ann. Phys.(N. Y.) 4, 306) relativistic Lagrangian and Low's (Low, F. E. 1958 Proc. Roy. Soc. 248, 282) hot plasma Lagrangian are also briefly discussed in the context of the present work. The behavior of the canonical stress tensor is considered. The applicability of many of the general results of part 1 (Dougherty, J. P. 1970 J. Plasma Phys. 4, 761) is ensured by establishing the existence of the Lagrangian function. (auth)

18439 ANALYSIS OF SIGNALS STRUCTURE IN A PLASMA-STREAM SYSTEM IN MULTI-FREQUENCY REGIME. Rogashkova, A. I.; Tseytlin, M. B.; Vilkova, L. P. (Inst. of Radiotechnology and Electrotechnology, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 5, 659-665(1974). (In Russian).

The possibility is shown of controlling the oscillation spectrum on the basis of numerical solution of nonlinear equations describing the interaction between an electron stream and plasma when the electrostatic instability is developed in a multi-frequency regime. The distribution of the amplitudes of the stream hf current harmonics along the interaction space is calculated at the initial velocity and current modulation of the stream at several frequencies. (auth)

Production

18440 (UCRL-50021-73-2) LASER-FUSION PROGRAM. Semiannual Report, July–December 1973. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Apr 1974. Contract W-7405-eng-48. 175p. Dep. NTIS $7.60.

Summaries are given of research on the following areas: (1) program overview, (2) solid-state lasers, (3) design analysis, (4) component development, (5) diagnostics, (6) laser fusion, (7) laser-plasma, experimental and theoretical, (8) basic studies and advanced concepts, (9) isotope separation, (10) propagation, (11) gas laser research and technology, (12) CO_2 laser program, and (13) program resources. (MOW)

18441 X-RAY EMISSION FROM LASER GENERATED PLASMAS. Mallozzi, P. J.; Epstein, H. M.; Jung, R. G.; Applebaum, D. C.; Fairand, B. P.; Gallagher, W. J. (Battelle Columbus Labs., OH). pp 165-220 of Fundamental and Applied Laser Physics. New York; John Wiley and Sons, Inc. (1973).

Theoretical and experimental studies of laser-produced high-Z radiative plasmas were conducted. A theoretical model and computer code were developed which include the effect of index of refraction, bremsstrahlung, recombination radiation, line radiation, single fluid shock hydrodynamics, separate kinetic temperatures for electrons and ions, and electron thermal conductivity. Its validity extends to highly nonequilibrium regimes such as the time-dependent corona regime. Computer calculations have been performed which predict that large fluxes of x rays can be generated by placing high-Z targets in the laser focus, with efficiencies in excess of 20% for converting laser light into x rays being feasible at 100 TW/sq cm of laser light incident over 1 nsec. (auth)

Stability

18442 (IPPCZ-179) SOME NONLINEAR PHENOMENA ASSOCIATED WITH HIGH-FREQUENCY BEAM-PLASMA INSTABILITIES. Piffl, V.; Sunka, P.; Ullschmied, J.; Jungwirth, K.; Krlin, L. (Ceskoslovenska Akademie Ved, Prague. Ustav Fyziky Plazmatu). Feb 1973. 20p.

High-frequency instabilities in a beam–plasma system were investigated experimentally. The measurements were performed on two experimental facilities. In one of them (beam current $\leq$ 50 mA at 5 kV) the plasma is created independently of the beam and in the range of parameters examined, only the instability with $\omega > \omega_{ce}$ is excited. In the other facility, the plasma is created by the electron beam itself (beam current up to 500 mA at 3 kV) and the process of the plasma buildup, up to the densities when $\omega_{pe} \approx \omega_{ce}$, is influenced only by the instability at frequencies $\omega < \omega_{ce}$. The working gas is argon. In both cases, the plasma is immersed in a homogeneous magnetic field ($\leq$ 800 G and 2000 G, respectively) and the number density of the plasma varies within the limits 10^9 to 10^{12} cm^{-3}. (Nuclear Sci. Abstr. Czech.)

18443 INFLUENCE OF THE EXTERNAL MODULATING FIELD ON NONLINEAR TWO-BEAM OSCILLATIONS OF PLASMA. Berman, G. P. (Novosibirsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 17: No. 5, 650-658(1974). (In Russian).

The behavior of a nonlinear plasma wave in a two-beam system in the presence of the external modulating field is considered. Some cases are considered by the method of the perturbation theory: the nonresonance interaction of the wave harmonics with the external field, one localized resonance and a great number of resonances between the wave harmonics and the external high-frequency field. Corrections are made in the dispersion equation which are due to the external field. The conditions of excitation of the stochastic instability when the motion of a plasma wave is close to braking are found. The region separating the stochastic motion from the stability region is estimated. (auth)

18444 ONSET CONDITION ON COUNTER-STREAMING ELECTRON BEAM INSTABILITY. Okutsu, E.; Hagiwara, S. (Tokyo Univ. of Education). Jap. J. Appl. Phys.; 13: No. 4, 688-692(Apr 1974).

Instabilities due to an interaction of counter-streaming electron beams in a magnetic field are studied experimentally. The onset conditions of the instabilities are examined in the case of an interaction between two electron beams with the same energy or different energies. Experimental results indicate that the onset condition appears to be determined by the competition between a linear growth rate of the instability and a damping rate caused by the end loss. (auth)

18445 PLASMA INSTABILITIES. Vol. I. D'Angelo, N. (Danish Space Research Inst., Lyngby). pp 14-40 of Summer School on Plasma Physics and Solar Radioastronomy. Meudon, France; Observatoire de Paris-Meudon ([nd]).

From proceedings of the summer school on plasma physics and solar radioastronomy; Ile de Re, France (4 Sep 1972).

Various types of plasma waves and instabilities observed in low-β plasmas: ion-acoustic waves, electrostatic ion-cyclotron waves, drift waves, and Kelvin–Helmholtz instability are reviewed. Applications of the results obtained to space physics are discussed: the heating of the solar corona by ion-acoustic wave damping auroral pulsations, and comet physics. (FR)

18446 FEEDBACK STABILIZATION OF PLASMAS. Rodriguez, G. Los Angeles; University of California (1974). 174p. University Microfilms Order No. 74-12,469.

Thesis (Ph. D.).

Some aspects of the control theory for systems describable by partial differential equations are developed and applied to solve a class of plasma stabilization problems governed by the ideal MHD equations. The basic plasma stabilization problem is formulated as a nonhomogeneous mixed initial-boundary-value (NMIBV) problem. The existence and uniqueness of generalized solutions to this problem are established. A set of eigenfunctions is defined, and its completeness is established. Consequently, the solutions to the NMIBV problem can be expanded in terms of these eigenfunctions. The question of controllability is studied, and it is established that all plasma motions which perturb the plasma surface can be controlled in principle. Various classes of stabilizing and optimal controls are derived. (Diss. Abstr. Int., B)

Thermonuclear Engineering and Equipment

Refer also to abstracts 18465, 18470, 18471, and 18479.

18447 (AD-757891) CHARGED COLLOIDAL PARTICLES FOR CONTROLLED THERMONUCLEAR REACTORS. Final Technical Report, 1 November 1968–30 November 1972. Hendricks, C. D. (Illinois Univ., Urbana (USA). Charged Particle Lab.). 1972. 11p. (AFOSR-TR-73-495). NTIS $3.00.

Particle, production, and control techniques developed in past investigations have led to the proposed use of similar techniques for reactor fuel handling and refueling of operating fusion systems. The development of methods of producing and controlling small particles of deuterium lithium deuteride and other CTR fuels has been one of the main goals of the research. Other efforts which were necessary to support the primary effort have been studies of ion-beam formation from liquid surfaces; electron-sheet-beam extraction and acceleration of ion-beams; analysis of wave phenomena on liquid jets; laser-initiated CTR plasmas and other peripheral studies have complemented the main thrust of the research. A number of significant results which have arisen from this research, are described. (auth)

18448 (AEC-tr-7561) STUDIES OF PULSED THERMONUCLEAR SYSTEMS IN THE USSR. Pinches and Relativistic Electron Beams. Rudakov, L. I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Jun 1974. Translated from Russian. 5p. Dep. NTIS $4.00.

Summaries of research are given for work on liners for theta pinch devices and the development of powerful relativistic electron beams. (MOW)

18449 (COO-2234-1) PROGRAM TO DEVELOP THE TECHNIQUES OF GENERATION AND CONTROL OF CRYOGENIC MATERIAL PARTICLES FOR USE ON FUSION SYSTEMS. Progress Report, June 1, 1972–May 31, 1973. Hendricks, C. D. (Illinois Univ., Urbana (USA). Charged Particle Lab.). [nd]. Contract AT(11-1)-2234. 7p. Dep. NTIS $4.00.

A method was developed for producing macroscopic deuterium particles to be injected into plasma machines such as TOKOMAKS. The purpose of the injection is for refueling and for diagnostics. In the particle generator, deuterium or hydrogen gas is liquified by cooling the gas by cold helium gas or liquid helium. The liquid hydrogen is formed into a liquid jet and caused to break up into uniform drops. The drops, when injected into a vacuum, freeze by evaporative cooling and become solid particles (spheres). An electric charge can then be put on the spheres and makes possible the attainment of high velocities by electrostatic acceleration. While particles may be produced with radii in the range of five to several hundred micrometers, current efforts involve production of particles with radii in the few tens of micrometers. (auth)

18450 (COO-2323-3) POTENTIAL WELL FORMATION IN ELECTROSTATIC CONFINEMENT DEVICES. Technical Progress Report. Cherrington, B. E.; Verdeyen, J. T. (Illinois Univ., Urbana (USA). Gaseous Electronics Lab.). 1974. Contract AT(11-1)-2323. 60p. Dep. NTIS $6.00.

The goal of this program is to evaluate the feasibility of using inertial electrostatic forces to confine energetic plasmas capable of sustaining fusion reactions. It was shown experimentally that electron injection into a spherical system under high vacuum conditions produces a deep negative potential well. The recent theoretical analysis of this system gives excellent agreement with the experimental results. Of much more importance is the observation of a stable multiple potential well structure (ion rich region in the center) when electrons are injected into a low pressure deuterium gas background. The extension of the theoretical analysis to explain these results do give qualitative agreement with the experimental results. (auth)

18451 (MATT-1048) TWO-ENERGY-COMPONENT FUSION REACTORS WITH SUSTAINED SUPRATHERMAL-ION ENERGY. Jassby, D. L.; Furth, H. P. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). May 1974. Contract AT(11-1)-3073. 19p. Dep. NTIS $4.00.

The energy multiplication factor of the D–T two-energy-component reactor scheme can be enhanced by a factor of about two if the suprathermal ion energy is "clamped" at the value W_0 that gives maximal ratio of fusion reaction rate to plasma drag. The optimal energy W_0 is in the range 105 to 145 keV (depending on T_e), significantly lower than the optimal energy in the conventional scheme. To realize the maximum gain, the clamping period must be many times the "slowing-down time," or else the suprathermal energy must be recovered (e.g., by magnetic decompression at the end of the clamping period). In a tokamak device there are several possible techniques for accomplishing energy clamping; the most promising is slow major-radius compression. Application of this method, whose principle has been demonstrated, could lead, for example, to a "break-even" device with $\langle T_e \rangle \approx 3.3$ keV, compression ratio 2.2, and $n\tau \sim 5 \times 10^{12}$ cm^{-3}sec. (auth)

18452 (N-74-10678) INITIAL RESULTS FROM THE NASA LEWIS BUMPY TORUS EXPERIMENT. Roth, J. R.; Richardson, R. W.; Gerdin, G. A. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). 1973. 38p. NTIS $4.00.

From annual plasma physics meeting of the American Physical Society; Philadelphia, Pennsylvania, USA (31 Oct 1973).

Initial results were obtained from low power operation of the NASA Lewis Bumpy Torus experiment, in which a steady-state ion heating method based on the modified Penning discharge is applied in a bumpy torus confinement geometry. The magnet facility consists of 12 superconducting coils, each 19 cm i.d. and capable of 3.0 T, equally spaced in a toroidal array 1.52 m in major diameter. A 18 cm i.d. anode ring is located at each of the 12 midplanes and is maintained at high positive potentials by a dc power supply. Initial observations indicate electron temperatures from 10 to 150 eV, and ion kinetic temperatures from 200 to 1200 eV. Two modes of operation were observed, which depend on background pressure, and have different radial density profiles. Steady state neutron production was observed. The ion heating process in the bumpy torus appears to parallel closely the mechanism observed when the modified Penning discharge was operated in a simple magnetic mirror field. (auth)

18453 LASER SYSTEM EMPLOYING RAMAN ANTI-STOKES SCATTERING. Carman, R. L. Jr.; Rhodes, C. K. (to United States Atomic Energy Commission). US Patent 3,815,043. 4 Jun 1974. Filed date 11 Jan 1973. 8p.

A laser system is described which employs a Raman anti-Stokes scattering process to produce high energy pulsed outputs of narrow pulsewidth and short wave-length, particularly useful in controlled fusion applications utilizing coherent optical pulses for plasma heating, and provides means for optically isolating the laser source from the laser system's target. (Official Gazette)

18454 LABORATORY EQUIPMENT FOR 100 kJ THETA-PINCH EXPERIMENT. Wu-li; 3: No. 1, 7-16(18 Feb 1974). (In Chinese).

A 100 kJ linear θ-inch experiment was set up to study the physical properties of plasma bodies. During the experiment, a scintillating counter was used to measure the neutron emission time; a GSJ-65 high-speed rotating camera was used to scan the plasma; the method of soft x-ray absorption was used to measure the temperature of the electrons; and a laser Mach–Zehnder interferometer was used to measure the electron density. The main parameters of the laboratory equipment were as follows: capacity 75 μf; maximum charging voltage 50 kV; peak current 1.6 mega-Amp; peak magnetic field intensity 82 kGauss/sec; half cycle 6.5 μs; and energy conversion rate ~ 50 percent.

18455 FUSION POWER: AN ASSESSMENT OF ITS POTENTIAL IMPACT IN THE USA. Kulcinski, G. (Univ. of Wisconsin, Madison). Energy Policy; 2: No. 2, 104-125(Jun 1974).

The prospects for harnessing fusion power are discussed. The economic and environmental aspects of fusion power plants are described. The problems that could arise in the cost and availability of refractory metals and alloying elements for construction of magnetically confined plasma reactors are discussed. (MOW)

Wave Phenomena

18456 (AD-762380) EXPERIMENTAL INVESTIGATIONS OF THE GROWTH AND DECAY OF PARAMETRICALLY EXCITED ION ACOUSTIC WAVES. Technical Report. Klein, L. A.; Cheo, B. R. (New York Univ., Bronx, N. Y. (USA). Dept. of Electrical Engineering and Computer Science). Apr 1973. 164p. (AFOSR-TR-73-1047). NTIS $10.50.

A new technique is described for experimentally determining growth and decay rates of parametrically excited ion acoustic waves in gaseous plasmas. A microwave signal acting through a Tonks-Dattner structure is the pump for the parametric process. By switching the pump power from above threshold to below, the near threshold value of the decay rate of the ion acoustic wave is determined and shown linearly related to pump power, in agreement with parametric theory. This relation is employed to calculate the damping frequency of the ion acoustic wave, a term proportional to the coupling coefficient between energy in the pump and parametrically excited waves, and the threshold power for onset of the parametric instability. (auth)

18457 ION-ACOUSTIC TURBULENCE IN COLLISIONLESS SHOCK WAVES AND ITS EFFECT ON THE STRUCTURE OF THE FRONT. Vekshtein, G. E. Zh. Prikl. Mekh. Tekh. Fiz.; No. 3, 38-43(1974). (In Russian).

The structure of the collisionless shock wave at whose front ion-acoustic turbulence is excited was examined. On the basis of the theory of abnormal resistance equations were obtained for the oscillation spectra and distribution function for the particles in the plasma. With these the profile of the magnetic field, the densities, and other macroscopic characteristics of the shock wave can be determined. The possibility of comparing the theoretical predictions with the results of experiments on the scattering of light on the front of the shock wave was discussed. (tr-auth)

18458 TRANSIENT ELECTROMAGNETIC PROPAGATION IN A UNIFORMLY MOVING DISPERSIVE MEDIUM. Pearlman, R. A. Philadelphia; University of Pennsylvania (1973). 67p. University Microfilms Order No. 74-14,124.

Thesis (Ph. D.).

The problem of a sinusoidal electromagnetic pulse in a uniformly moving, isotropic plasma was examined. The Fourier components of the pulse were transformed into the moving frame through the Lorentz transformation, and the dispersion relation in the moving frame was derived, using the inverse Doppler equation. The total pulse was obtained by integrating the Fourier components in the complex frequency plane, using a steepest descent approximation. The observed pulse is shown to have a long precursor, followed by a rapid rise toward the steady state pulse level, when the plasma is moving slower than the group velocity of the pulse. Only the precursor or transient is observed when the plasma is moving faster. (Diss. Abstr. Int., B)

18459 LINEAR TRANSFORMATION OF WAVES IN AN INHOMOGENEOUS PLASMA. Davidova, T. O. (Institut Ladernikh Doslidzhen, Kiev). Ukr. Fiz. Zh. (Ukr. Ed.); 18: 2035-2042(Dec 1973). (In Ukrainian).

Freman and Freman's (1967) F-matrix method (based on the introduction of a "scattering" matrix that relates the wave amplitudes before and after interaction) developed for studying the applicability of the WKB approximation to second-order differential equations is extended to the study of linear interactions between two waves of different type in an inhomogeneous plasma. The method makes it possible to obtain conjugate formulas which relate the solutions of fourth-order equations on either side of the interaction region, and to determine the existence of localized solutions in the presence of interacting waves of different type. (IAA)

18460 INSTABILITY AND COUPLING OF LARGE-AMPLITUDE ELECTRON-WAVE SIDEBANDS. Jahns, G. L. Irvine, CA; University of California (1973). 192p. University Microfilms Order No. 74-13,850.

Thesis (Ph. D.).

A launched large-amplitude electron-plasma wave drives an instability which results in the growth of sideband excitations at nearby frequencies. Previous experiments have shown that the instability is associated with electrons, moving with the wave, which are trapped and then oscillate in the wave potential

wells. A number of theories, employing different mechanisms, have subsequently been presented to explain this effect. This work presents new measurements of the instability designed specifically to test the various theories and to render more clearly the underlying physical mechanism of the instability. Wave dispersion, amplitude development with distance, and spectra are determined empirically, as a function of large wave level and phase velocity. From these measurements, the following salient points are examined: (1) the initial development of the instability using launched small-amplitude test waves at the sideband frequencies; (2) the dependence of the growth rate on wave parameters; (3) the behavior at low phase velocities where the large-amplitude wave strongly decays; and (4) mode coupling between applied or spontaneous sidebands. (Diss. Abstr. Int., B)

ENGINEERING

18461 (SCTM-53-61(14)) INSPECTOR ACCURACY: A STUDY OF THE LITERATURE. McCornack, R. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). Feb 1961. 30p. Dep. NTIS $4.50.

Much of the work on inspector accuracy done by others and reported in the literature (prior to May 1959) touches on problems of direct concern to Sandia Corporation. This paper discusses and presents summaries of such studies made on the accuracy of industrial inspectors. Kinds of inspector bias are reported, and various measures of inspector accuracy described. A new measure is suggested. General conclusions and specific problems are pointed out. Man considered as a monitor receives a short treatment, and some general comments on the state of studies in this area are ventured. (auth)

18462 (SCTM-93-62-(14)) REDUCTION OF HUMAN ERROR IN INDUSTRIAL PRODUCTION. Rook, L. W. Jr. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jun 1962. 25p. Dep. NTIS $4.25.

Within the field of nuclear ordnance there is emphasis upon both high reliability and a "no field test" design philosophy. The result of this is that human error in design and production assumes high importance with respect to nuclear weapon system degradation. An initial approach to reducing degradation from these sources has been made within Sandia Corporation by the construction of a model of human error which possesses validity with respect to both psychological concepts and operational procedures. The model consists of two cross-cutting systems of classification, each with three categories. One system is essentially that reported by Payne and Altman in their "An Index of Equipment Operability" while the other is of our own devising and is based on the intent of the perpetrator of the error. This latter can seldom be ascertained directly, but can usually be implied from the evidence available. The two classification schemes combine to produce nine subcategories or error modes, each with unique properties which have value in diagnosing the causes of error. Error frequencies within each of these modes are combined with system parameters to produce a quantitative model which provides both evaluation of system performance and an estimate of the contribution of each potential error to system degradation. (auth)

Energy Conversion

18463 (AD-771959) HIGH POWERED FLAME HEATED THERMIONIC POWER SOURCE MODULE. Final Report 1 June 1972-1 June 1973. Engdahl, R. E.; Engelberger, J. F.; Baker, B. S. (Energy Research Corp., Bethel, Conn. (USA)). Dec 1973. 75p. (ECOM-222/F/71). NTIS $3.50.

Drawing upon technology acquired in the development of a 100 W flame-heated thermionic diode, the contractor addressed the development effort toward a scale up to 1300 W. The design concept called for a multiplicity of diodes serially connected in a single module. This was deemed necessary to minimize losses in power extraction and in power conditioning. Accomplishments included fabrication of SiC flame barriers in the size required and development of multiple layer refractory metal and insulation assembly techniques using chemical vapor deposition. (GRA)

18464 (AED-Conf-74-030-006) TECHNICAL SPECIFICATIONS FOR THE SAFETY OF RADIONUCLIDE BATTERIES FOR CARDIAC PACEMAKERS. Wieser, K. (Bundesanstalt fuer Materialpruefung, Berlin (F. R. Germany)). 1974. 8p. (In German). INIS.

From symposium on safety aspects of implanted cardiac pacemakers, with special regard to radionuclide batteries; Berlin F. R. Germany (1 Mar 1974).

1 fig.; 2 refs.

Regulations concerning design test (e.g., impact test, static pressure test, fire and corrosion test) and a quality control program are briefly discussed. These guidelines have been laid down in the Interim Radiation Protection Standards of the NEA, of January 9, 1974 and have already been recommended in a publication of the BMI of Oct 31, 1973. (GE)

18465 (ANL-Trans-953) ON THE DIRECT TRANSFORMATION OF ENERGY OF IONS IN OPEN MAGNETIC TRAPS. Vinogradova, O. A.; Dimitrov, S. K.; Zhutlukhin, A. M.; Lutsko, A. S.; Smirnov, V. M.; Telkovski, V. G. Translated from At. Energ. (USSR); 36: No. 3, 221-222(Mar 1974). 7p. Dep. NTIS $4.00.

The basic parameters at the exit of the expander in the recovery system of an open-type thermonuclear reactor are described. Some experiments on energy recovery from dense ion beams are discussed. The experiments used an ion source, accelerating collimator, focusing lens, rotating Faraday cups, collimators to extract electrons from the beam, and a system of SSD collimators. (MOW)

18466 (GA-A-12848) RADIOISOTOPE SPACE POWER GENERATOR. Annual Summary Report, July 1, 1971-June 30, 1972. Elsner, N. B.; Postula, F. D.; Bradshaw, G. C.; Steeger, E. J.; Leedy, R. L.; Mautz, C. W. (Gulf General Atomic Co., San Diego, Calif. (USA)). 1 Mar 1974. Contract AT(04-3)-943. 95p. Dep. NTIS $7.75.

The Isotec Technology FY1972 Annual Summary Report is an account of several different efforts: (1) continuing development in fabricating and characterizing TAGS, (2) segmenting of different combinations of materials, such as PbSnMnTe/BiSbTe and PbSnMnTe/TAGS, (3) isothermal testing in ultra-high vacuum of SiGe and SiMo to determine their free vaporization rate and compatibility with different insulations, (4) studies of a means for measuring intermediate range thermal conductivities with small samples of material, and (5) transit activities, which consisted of TRANSIT launch support, fabrication of a display model of the generator, and thermoelectric testing. (auth)

18467 (GA-A-12914) MANUFACTURING PLAN ERTG RING CONVERTER. Final Status Report. (Gulf General Atomic Co., San Diego, Calif. (USA)). 1 May 1974. Contract AT(04-3)-943. 85p. Dep. NTIS $7.25.

This Manufacturing Plan covers the control of all purchases of materials and the manufacture of all components and assemblies for the RING converter for the economical radioisotope thermoelectric generator (ERTG). The plan covers the time span from the approval of engineering drawings through the manufacture of hardware. All manufactured parts and assemblies, from the release of engineering drawings through the manufacture of the RING converter, will be controlled by manufacturing control documents and by quality assurance. This plan is a revision of the TRANSIT plan (GACD-9684) and has been modified to fit the RING converter. A considerable number of tasks and requirements of TRANSIT are directly applicable to the fabrication of the RING converter. Those items in the TRANSIT plan not applicable to the RING were removed, while other new or unique items were added. Appendix A lists the equipment needed for the RING converter fabrication. Appendix B presents the development status of materials, processes and testing. (auth)

18468 (GA-A-12915) PROJECT DEVELOPMENT PLAN AND COST ESTIMATE, ERTG PROGRAM. Final Status Report. (General Atomic Co., San Diego, Calif. (USA)). 5 Apr 1974. Contract AT(04-3)-943. 22p. Dep. NTIS $4.25.

The economical radioisotope thermoelectric generator (ERTG) program assumes that the first flight generator will be launched during 1978. The program planned to meet this goal and the costs associated with the five phases of the program are presented. It is concluded that: the low cost RING converter can meet all system objectives using the existing technology of PbTe-PbSnMnTe/BiSbTe if the maximum heat source cost is $150/W(th); the low cost RING converter is a growth vehicle since the TPM alloys can be implemented in the converter with minimal impact, and this implementation will greatly lower cost and reduce size and weight; and the RING converter allows minimal constraints on the heat source development program. (LCL)

18469 (GA-A-12922) PRELIMINARY EVALUATION OF THE RING CONVERTER SECTION DEMONSTRATION TEST. Bradshaw, G. B. (Gulf General Atomic Co., San Diego, Calif. (USA)). 9 Mar 1974. Contract AT(04-3)-943. 34p. Dep. NTIS $4.75.

A preliminary analysis and summary of performance data measured on the General Atomic Ring Converter Section are reported. The Ring converter is an advanced concept for a very lightweight, low-cost thermoelectric converter that applies the technology developed for the TRANSIT RTG. The objective of the performance test on the Ring converter was to demonstrate the electric power output of this first manufacturing prototype model. A photograph of the test unit is shown. (TFD)

18470 (UCRL-51557) DART: A SIMULATION CODE FOR A DIRECT ENERGY CONVERTER FOR FUSION REACTORS. Howard, B. C.; Barr, W. L.; Moir, R. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 May 1974. Contract W-7405-eng-48. 93p. Dep. NTIS $5.45.

The DART code simulates the behavior of the charged particles which leak out of a mirror fusion reactor and are electrically recovered in a direct energy converter. The code was used to design a laboratory-scale direct energy converter. A full-

scale reactor converter is now being designed. The simulation technique, which includes space charge and secondary particle effects, and the method for calculating the efficiency with which the ion energy is converted to electricity is described. Output examples and listings of DART and several directly related codes are given. (auth)

18471 PLASMA ENERGY TO ELECTRICAL ENERGY CONVERTER. Moir, R. W. (to United States Atomic Energy Commission). US Patent 3,816,771. 11 Jun 1974. Filed date 9 Feb 1973. 6p.

Plasma from a fusion reactor is directed along a straight-line path and then converted directly to electrical energy by means of a plurality of parallel arrays of "venetian blind" collector grids, the planes of the arrays being mutually parallel and transverse to the plasma path. A relatively low retarding potential is applied to the first collector grid array for collecting low-energy ions, while successively higher retarding potentials are applied to each succeeding grid array for collecting ions of corresponding higher energy. The angles of the "venetian blind" grid arrays are adjusted to make them highly transparent to oncoming particles and highly opaque to particles that pass through but have insufficient energy to reach the next grid array and so return to and are collected by the preceding grid array. (Official Gazette)

18472 THERMOELECTRIC GENERATOR. Hursen, T. P.; Kokenik, S. A.; Purdy, D. L. (to Arco Nuclear). US Patent 3,818,304. 18 Jun 1974. Filed date 12 Aug 1971. 14p.

A heat-to-electricity converter is disclosed which includes a radioactive heat source and a thermoelectric element of relatively short overall length capable of delivering a low voltage of the order of a few tenths of a volt. Such a thermoelectric element operates at a higher efficiency than longer higher-voltage elements; for example, elements producing 6 volts. In the generation of required power, thermoelectric element drives a solid-state converter which is controlled by input current rather than input voltage and operates efficiently for a high signal-plus-noise to signal ratio of current. The solid-state converter has the voltage gain necessary to deliver the required voltage at the low input of the thermoelectric element. (Official Gazette)

18473 MHD POWER GENERATION. Gupta, D. R. J. Inst. Eng. (India), Mech. Eng. Div.; 53: No. ME 3, 115-118(Jan 1973).

MHD power generation is discussed. The basic ideas associated with plasma MHD (open and closed cycle) and liquid metal MHD are stated. The USSR open cycle program and both American and Russian efforts in the liquid metal area are mentioned briefly, but there is no reference to current American work in either open or closed cycle plasma MHD. (Appl. Mech. Rev.)

18474 INVESTIGATION OF PLASMA ACCELERATION IN CROSSED ELECTRIC AND MAGNETIC FIELDS. Aref'ev, V. I.; Khmelinin, B. A. High Temp. (USSR) (Engl. Transl.); 11: No. 4, 643-650(1973).

Translated from Teplofiz. Vys. Temp.; 11: No. 4, 713-723(1973).

Plasma acceleration regimes in crossed electric and magnetic fields, when the density of the Hall current flowing in the interelectrode space exceeds considerably the critical current value, as a consequence of which the plasma flow in the MHD channel becomes unstable and turbulent, were investigated. Experimental relations characterizing the distribution of the amplitudes of velocity fluctuations of the plasma flow over the cross section of the MHD channel were obtained, and two fluctuation spectra, low- and high-frequency, were established and investigated. A theoretical analysis of the observed instabilities is given, and the criteria of their excitation are established. A self-consistent nonlinear theory of low- and high-frequency instability, taking into account the effect of unstable fluctuations during acceleration and heating of plasma in a MHD channel, is constructed. (auth)

18475 INVESTIGATION OF THE PROPERTIES OF ALKALI-RESISTANT REFRACTORY MATERIALS FOR THE LINING OF VARIOUS UNITS OF MHD INSTALLATIONS. Romanov, A. I.; Vysotskii, D. A.; Smirnova, L. G.; Samsonov, V. P.; Golubkova, A. S. (Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 11: No. 4, 767-772(1973).

Translated from Teplofiz. Vys. Temp.; 11: No. 4, 858-864(1973).

The selection and processing of alkali-resistant refractory materials for the lining of low-thermal-stress units of MHD installations is considered. Refractory materials with a high (90% or more) content of MgO or Al_2O_3 and minimal porosity are the most resistant. The technology is developed, and the properties of high-silica concrete for the lining of the air flue elements and of magnesia concrete in a water glass binding for the lining of the steam generator of a U-25 installation are investigated. The corrosion processes for refractory materials treated with a melt of potash during storage in air are investigated. The role of the hydration by air moisture of the potash contained in the pores of a refractory material in the corrosion processes in ceramics is shown. A criterion for an estimate of the resistance of porous refractory materials is proposed. (auth)

18476 PHOTOIONIZATION WITHOUT THERMAL EQUILIBRIUM IN COMBUSTION GAS–POTASSIUM WORKING MEDIUM. Antal, K.; Bolla, I. Musz. Tud.; 47: No. 3-4, 249-257(1973). (In Hungarian).

The possibility of maintaining the required ionization degree of the working gas in the channel of the MHD generator after the adiabatic expansion is analyzed by injection of incandescent coal grains. On the basis of the ionization equation and the energy balance for different possible MHD-parameters, the critical temperature and the quantity of the incandescent coal grains necessary for maintaining the ionization are given. (auth)

Facilities and Equipment

Refer also to abstract 18440.

18477 (GA-A-12864) PRIMARY JAW CRUSHER DEVELOPMENT. Baxter, B. J.; Gasparovic, A.; Bond, A. H. (Gulf General Atomic Co., San Diego, Calif. (USA)). 28 Feb 1974. Contract AT(04-3)-167. 56p. Dep. NTIS $5.45.

Results of experiments performed with conventional jaw crushers are described. These tests were designed to evaluate the suitability of these machines for the crush, burn, leach concept of HTGR head-end fuel reprocessing. The present burn requirements are such that it is necessary to reduce standard fuel and control rod elements to less than $^3/_{16}$ in. (4.8 mm) ring-size particles. An ancillary requirement is that during crushing the TRISO coated fuel particles remain intact. A reduction of fuel and control rod elements to the $^3/_{16}$ in. (4.8 mm) size requires a large overall reduction from the original element size which, by its very nature, is violent. The only mechanical devices that are used in commercial applications to make such size reductions are termed primary crushers and are principally utilized by the mining industry. Although other types of primary crushers and various specialty size-reduction techniques exist, and were in some instances tested, the jaw crusher stands out as the most suitable device for head-end fuel reprocessing. (auth)

18478 (IAE-2248) PRODUCTION OF DISTRIBUTED ELECTRIC DISCHARGE IN PULSED CO_2 LASER AND SOME PECULIARITIES OF LASER RADIATION. Baranov, V. Yu.; Borisov, V. M.; Vedenov, A. A.; Drobyazko, S. V.; Knizhnikov, V. N.; Napartovich, A. P.; Niz'ev, V. G.; Strel'tsov, A. P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1972. 20p. (In Russian). INIS.

The problems of homogeneity of an electric charge between extended electrodes are examined. Possible causes leading to formation of current channels are considered. Experiments were made on various electrode constructions. Results are presented of studies on the characteristics of laser radiation. Theoretical calculations were made on the characteristics of the output radiation, energy, pulse shape, and pulse charge after the current pulse. Calculated values agreed well with experimental measurements. (tr-auth)

18479 (LA-5538) FITWEIB: A PROGRAM TO FIT FAILURE DATA TO WEIBULL PROBABILITY PARAMETERS. Boicourt, G. P. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1974. Contract W-7405-eng-36. 18p. Dep. NTIS $4.00.

The Weibull probability distribution describes the failures of many electrical and mechanical components. Tests can be carried out to obtain raw data on failures experienced by a given component type. The computer program described in this report can be used to find the parameters of the Weibull distribution that best fits these data. The fitting methods are discussed, the program is described, input instructions are given, and an example is presented. (auth)

18480 (ORNL-TM-4567) ASSESSMENT OF COATER SIZE FOR THE FUEL REFABRICATION PROTOTYPE PLANT. Lackey, W. J.; Jenkins, J. D.; Homan, F. J.; Lowrie, R. S. (Oak Ridge National Lab., Tenn. (USA)). Jul 1974. Contract W-7405-eng-26. 21p. Dep. NTIS $4.00.

An assessment of the economic and technical advantages and disadvantages associated with use of 9-in.-diam coaters in a remote HTGR refabrication plant rather than use of 5-in.-diam coaters was conducted. The larger coater is clearly favored from the economic standpoint. Criticality considerations dictate that 9-in.-diam coaters must never be flooded with hydrogenous materials and thus the furnace coolant and soot scrubbing media cannot be water or any other hydrogenous material. Suitable alternate materials that are not good moderators appear to be available. Development of a 9-in.-diam coater to the state of development

currently existing for the 5-in.-diam prototype remote coater would require about one million dollars and 2½ to 3 years. It is recommended that 5-in.-diam coaters be used in the TURF prototype plant, but also recommended is the immediate parallel development of the 9-in.-diam coater. (auth)

18481 (SLA-74-0115) SHOCK LABORATORY DATA SYSTEM. Porter, D. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jul 1974. Contract AT(29-1)-789. 97p. Dep. NTIS $8.00.

The Shock Laboratory Data System at Sandia Laboratories is a minicomputer-based data gathering system designed to take accelerometer data, condition and digitize it, and store the real time information for either a "quick look" or a more detailed analysis. Capabilities include: shock spectrum, Fourier analysis, and transfer of data in compatible format on digital magnetic tape to a CDC-6600 computer for a more detailed analysis. This report provides a general overview of system capabilities, specifics as applied to system design, development and hardware makeup, and standard operating procedures. (auth)

18482 (UCRL-13557) INVERSE RAMAN STUDIES OF CHEMICAL LASERS. Final Report. Lytle, F. E. (Purdue Univ., Lafayette, Ind. (USA). Dept. of Chemistry). Sep 1972. Subcontract 4752609. 19p. Dep. NTIS $4.00.

For Univ. of California, Livermore.

A feasibility study concerned with the analytical applications of inverse Raman spectroscopy (IRS) to gas phase chemical detonations is described. The original appraisal of the problem indicated that the specific first year's goal should be the recording of IRS data for pure gases at 10 to 25 torr. This achievement was not realized primarily due to major equipment failures lasting the first eight months of the contract. In the remaining four months earlier published work was repeated and a dye laser was constructed that improved the detectability of the continuum signal by four orders of magnitude. The experience gained has strengthened the belief that IRS can be engineered into a viable analytical technique for providing time resolved concentration and structural data. (auth)

18483 (UCRL-51574) METHOD FOR COMPUTER SIMULATION OF PROBLEMS IN SOLID MECHANICS AND GAS DYNAMICS IN THREE DIMENSIONS AND TIME. Wilkins, M. L.; Blum, R. E.; Cronshagen, E.; Grantham, P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Apr 1974. Contract W-7405-eng-48. 87p. Dep. NTIS $5.45.

Details are given for a versatile computer program that employs finite element and finite difference techniques to describe complex physical phenomena in three dimensions and time. Applications include problems in gas dynamics, elasticity, dynamic plasticity, fracture, and thermal conduction. The main features of the program are illustrated by a calculation that determines the thermal-shock stresses in a stator blade of a gas turbine engine. Appendices present an outline of SOLID SAP, a complete mathematical development of HEMP 3D, a comparison between finite difference and finite element methods, and descriptions of subroutines for discretizing, for display, and for calculation of three-dimensional thermal diffusion. (auth)

18484 PHYSICS, OPTICS: STUDIES OF THE He–Cd^+ METAL-VAPOR LASER. Brown, D. C. New York; Syracuse Univ. (1973). 213p. University Microfilms Order No. 74-8233.

Thesis (Ph.D.).

An experimental investigation of the He–Cd^+ laser was undertaken with a view towards studying the causes and suppression of noise impressed upon the output intensity of the 4416 Å, ($5s^2D_{\frac{5}{2}} \rightarrow 5p^2P_{\frac{3}{2}}$) laser transition, and obtaining direct confirmation of the Penning effect as being the basic dominant excitation mechanism for both the 4416 Å and 3250 Å ($5s^2D_{\frac{5}{2}} \rightarrow 5p^2P_{\frac{3}{2}}$) transitions. The results of this research are the attainment of the lowest noise figure to date (0.14%) (RMS noise/DC level × 100), and successful completion of an absorption experiment which provides direct confirmation of the Penning Effect through the collision process ($He^*(2^3S) + Cd^0 = He(1^1S) + e^- + K.E. + Cd^+$ + for the 4416 Å transition. An undecidable result was obtained for the 3250 Å transition because of overlapping of adjacent spectral lines. (Diss. Abstr. Int., B)

18485 CW SUBMILLIMETER LASER GENERATION IN OPTICALLY PUMPED STARK-TUNED NH_3. Fetterman, H. R. (Massachusetts Inst. of Tech., Lexington); Schlossberg, H. R.; Parker, C. D. Appl. Phys. Lett.; 23: No. 12, 684-686(15 Dec 1973).

Submillimeter laser action was achieved in ammonia by Stark shifting vibrational absorption lines into resonance with a CO_2 laser pump. In two of the three observed cases the absorption line was between states of the same parity, i.e., forbidden in the absence of the applied Stark field. Stark tuning of a vibrational absorption into resonance with a pump laser line is a general technique which should greatly increase the number of stable cw submillimeter lines available at milliwatt power levels. (auth)

18486 SHORT-PULSE EXCITATION OF A XENON MOLECULAR DISSOCIATION LASER AT 172.9 nm BY RELATIVISTIC ELECTRONS. Wallace, S. C.; Hodgson, R. T.; Dreyfus, R. W. (Thomas J. Watson Research Center, Yorktown Heights, NY). Appl. Phys. Lett.; 23: No. 12, 672-674(15 Dec 1973).

Laser action at 172.9 nm was observed in xenon and krypton–xenon mixtures following short-pulse excitation (2.5 nsec) by a relativistic electron beam. Peak powers ~80 kW cm^{-2} in a 5-nsec pulse were obtained. The pumping scheme used in this work is noteworthy because its high efficiency has made it possible to utilize a simple compact electron accelerator (total electron beam energy 6 J) for excitation. The present short-pulse data suggest that the rapid decrease in energy efficiency of this laser at high xenon pressures may be due to excited-state quenching by ground-state xenon atoms. (auth)

18487 ENHANCEMENT OF PHOTOELECTRON DENSITY IN TEA LASERS USING ADDITIVES. Seguin, H. J. J.; Tulip, J.; McKen, D. (Univ. of Alberta, Edmonton). Appl. Phys. Lett.; 23: No. 9, 527-529(1 Nov 1973).

The photoplasma produced in laser gases by a spark uv source is measured using a microwave bridge. The results show that an increase in plasma density of four orders of magnitude is obtained using trace amounts of low-ionization-threshold additives in the gas mix. The technique was shown to enhance laser performance. An output energy density of 60 J/liter was obtained from such a photoionized TEA laser. (auth)

18488 WAVEGUIDE TEA LASER. Smith, P. W.; Maloney, P. J.; Wood, O. R. II. (Bell Telephone Labs., Holmdel, NJ). Appl. Phys. Lett.; 23: No. 9, 524-526(1 Nov 1973).

A miniature transverse-excitation CO_2 laser is described in which the 10.6-μm laser radiation is confined within a hollow rectangular-cross-section dielectric and metal waveguide. Using a flowing mixture of CO_2, N_2, and He laser action was obtained at pressures up to 1 atm, and pulse repetition rates as high as 4kHz. (auth)

18489 NdLa PENTAPHOSPHATE LASER PERFORMANCE. Damen, T. C.; Weber, H. P.; Tofield, B. C. (Bell Telephone Labs., Holmdel, NJ). Appl. Phys. Lett.; 23: No. 9, 519-520 (1 Nov 1973).

Laser operation is reported in a new crystalline material with high Nd content (2×10^{21} cm^{-3}) whose concentration quenching is smaller than in other hosts. This material, NdLa pentaphosphate ($Nd_{0.5}La_{0.5}P_5O_{14}$) in the form of a 35-μm-thick crystal platelet was pumped with a pulsed Rhodamine 6G dye laser. The oscillation threshold with feedback from the uncoated surfaces was ~20 μJ of absorbed pump light. This indicates an optical gain coefficient of ~800 cm^{-1} corresponding to an excitation of more than half of the Nd ions in the material. This high gain resulted in a compression of the cavity mode spacing by a factor of 14. Using external mirrors, cw oscillation with a threshold of 25 mW absorbed power of an argon laser was achieved with a 1.4-mm-thick crystal. Measured parameters of the lasers are in good agreement with theory. (auth)

18490 CLOSED-FORM SOLUTION FOR EXCITED-STATE POPULATIONS IN TEMPORALLY AND SPATIALLY VARYING LASING MEDIA. Curry, B. P.; Zwick, S. A.; Aliprantis, C. D. (STD Research Corporation, Arcadia, CA). Appl. Phys. Lett.; 23: No. 10, 574-575(15 Nov 1973).

A class of equations is solved in which excited-state populations are coupled by radiative, collisional, and pumping terms having specified time and position dependence. These equations are decoupled by expansion of the excited-state populations and the pumping terms in eigenvectors of the collisional transition matrix. The solutions are ordered in such a way that the first-order solution is equivalent to neglecting temporal variations in radiation intensity, the higher-order solutions introduce time-dependent state mixing effects as a consequence of strong transitions. The second-order solution is stated explicitly and a prescription given for obtaining higher-order corrections. (auth)

18491 HF AND DF LASERS BY DIRECT ELECTRICAL DISCHARGE EXCITATION. Byron, S. R.; Nelson, L. Y.; Mullaney, G. J. Appl. Phys. Lett.; 23: No. 10, 565-567(15 Nov 1973).

Using a high-current long-pulse electron-beam-stabilized electrical discharge, laser oscillation was observed on several vibration-rotation bands of HF and DF in mixtures containing less than 1% HF or DF. Results in HF/argon mixtures with 10% added N_2, H_2, or D_2 established that HF is vibrationally pumped by direct electron impact and also by vibrational energy transfer from H_2. Rotational nonequilibrium as well as cascade coupling between 3 → 2 lines and 2 → 1 lines were inferred from the time sequence of the laser emission. (auth)

18492 HIGH-EFFICIENCY Nd^{3+}:$LiYF_4$ LASER. Sharp, E. J.; Horowitz, D. J.; Miller, J. E. (Night Vision Lab., Fort Belvoir, VA). J. Appl. Phys.; 44: No. 12, 5399-5401(Dec 1973).

Pulsed room-temperature laser action was observed in Nd^{3+}: $LiYF_4$ at 1053 nm. A threshold of 8 J and a slope efficiency of 0.82% was obtained with a 60% reflectivity output mirror. These results are compared to Nd^{3+}: YAG data taken in the same cavity. Loss coefficients are calculated for each material and are compared. (auth)

18493 ELIMINATION OF DEGRADATION IN THE LASER OUTPUT FROM Ho^{3+} IN SENSITIZED YAG. Johnson, L. F.; Ingersoll, K. A. (Bell Telelphone Labs., Inc.; Murray Hill, NJ). J. Appl. Phys.; 44: No. 12, 5444-5446(Dec 1973).

At the present time the most efficient insulating crystal laser is α-YAG (Ho^{3+} in sensitized YAG), but the 2.1-μ cw output from many α-YAG crystals undergoes a degradation under continuous tungsten lamp illumination. With the aid of a series of liquid optical filters, it is shown that degradation is caused by high-energy pump photons. At least three different types of degradation are produced depending on the wavelength of pump radiation, but all may be eliminated with a liquid filter that absorbes radiation below 5000 Å. (auth)

18494 SPATIAL DISTRIBUTION OF IONIZATION IN ELECTRON-BEAM-CONTROLLED DISCHARGE LASERS. Boyer, K.; Henderson, D. B.; Morse, R. L. (Los Alamos Scientific Lab., NM). J. Appl. Phys.; 44: No. 12, 5511-5512(Dec 1973).

The uniformity of energy deposition from the primary (ionizing) beam from the electron-beam-controlled discharge laser was examined especially considering the magnetic deflections and the scattering collisions. The addition of a parallel guide magnetic field was found to be useful. (auth)

18495 EFFECT OF AN ORGANIC GAS ADDITIVE ON A PULSE HF CHEMICAL LASER. Paulson, R. F. (Aerospace Research Labs., Wright-Patterson AFB, OH). J. Appl. Phys.; 44: No. 12, 5633-5636(Dec 1973).

The use of a small amount of xylene as a gas additive to a SF_6: H_2 mixture in an electrically initiated pulse hf chemical laser was shown to increase laser peak power output. For the experimental conditions of this work, enhancement of output power was seen only for laser medium pressures greater than 200 torr. A maximum increase in peak power of 60% was observed for a pressure of 300 torr. (auth)

18496 MODIFICATIONS OF THE THEORETICAL MODEL FOR A SELF-PULSING RING LASER. Halford, C. E. (Memphis State Univ.). J. Appl. Phys.; 44: No. 12, 5644-5646(Dec 1973).

The theoretical model for a self-pulsing ring laser was modified by confining the active medium to a length less than the cavity length. Some of the results of this modification are reported. Also, a more general type of loss was considered and the results are included. (auth)

18497 SPARK PUMPED DYE LASER WITH HIGH REPETITION RATE AND LOW THRESHOLD. Ferrar, C. M. (United Aircraft Research Labs. East Hanford, CT). Appl. Phys. Lett.; 23: No. 10, 548-549(15 Nov 1973).

A short unconfined spark is imaged by a spherical reflector into a small dye cell. Lasing is achieved for electrical inputs as small as 5 mJ. Pulse repetition rates as high as 2000 pulses/sec (pps) were attained. A tilted etalon permits wavelength tuning of the laser output. (auth)

18498 ELECTRON-BEAM-INITIATED CHEMICAL LASER IN SF_6-H_2 MIXTURE. Gross, R. W. F.; Wesner, F. (Max-Planck-Institut fuer Plasmaphysik Garching, Ger.). Appl. Phys. Lett.; 23: No. 10, 559-561(15 Nov 1973).

A 3.5-cm × 35-cm planar field emission electron beam diode, producing a total beam current of 4.65 kA of 120-keV electrons in 26-nsec pulses was used to initiate the reaction of F with H_2 in SF_6-H_2 mixtures. From an optical volume of approximately 1 liter one observes HF laser pulses of 20-30 nsec duration with a maximum energy of 0.2 J at 450 torr. The application of a secondary potential, very near the self-breakdown limit of the gas, to the laser medium increased the laser output by only a factor of 2. Numerical analysis of the experiments without secondary field shows that 2.7×10^4 F atoms are produced by each 120-keV electron fully stopped in the gas. This corresponds to an energy of 4.5 eV requires for the production of one F atom from SF_6 by high-energy electrons. The conversion efficiency of electron beam energy input to the medium to laser output energy was 5.2%. (auth)

18499 CONTINUOUSLY TUNABLE HIGH-PRESSURE CO_2 LASER WITH UV PHOTOPREIONIZATION. Alcock, A. J.; Leopold, K.; Richardson, M. C. (National Research Council of Canada, Ottawa). Appl. Phys. Lett.; 23: No. 10, 562-564(15 Nov 1973).

The operation of a uv photoinitiated transverse-discharge CO_2 laser was investigated at presures up to 15 atm. Preliminary studies of a device having an active volume of ~13 cm^3 have yielded a maximum output of ~1 J in 30 nsec, while the use of a grating-tuned resonator has resulted in continuously tunable operation over frequency intervals of ~20 cm^{-1}. (auth)

18500 EFFICIENT LOW-BAND OPERATION OF A CO CHEMICAL LASER. Jeffers, W. Q.; Wiswall, C. E. (McDonnell Douglas Research Labs., St. Louis). Appl. Phys. Lett.; 23: No. 11, 626-627(1 Dec 1973).

A cw O/CS_2 CO chemical laser was operated at a chemical efficiency of 37.5%. This result was achieved by the use of N_2O as a diluent whose V-V transfer effects on the chemically formed CO are such as to strongly enhance emission in the low vibrational bands. The free-running oscillator spectra start at $\nu = 12 \rightarrow 11$ and continue to $\nu = 2 \rightarrow 1$, with more than 50% of the output in the low bands $6 \rightarrow 5$ to $2 \rightarrow 1$. These results again emphasize the importance of vibrational energy transfer in chemical laser media. (auth)

18501 ANALYSIS OF A COLLISIONALLY INDUCED DIPOLE LASER. Christiansen, W. H.; Greenfield, E. (Univ. of Washington, Seattle). Appl. Phys. Lett.; 23: No. 11, 623-625(1 Dec 1973).

An electric dipole moment is induced in homonuclear molecules during collisions, allowing radiative transitions which are otherwise forbidden. This effect, coupled with high-pressure electrical excitation, may be used to achieve laser action in a homonuclear gas. Properties of this type laser include a very broad gain bandwidth and a new type of partial inversion. A mixture of H_2 and Xe is analyzed as a prospective system wherein efficiencies of about 20% are predicted for picosecond pulses at 2.8 μm. (auth)

18502 SINGLE HETEROJUNCTION $Pb_{1-x}Sn_xTe$ DIODE LASERS. Walpole, J. N.; Calawa, A. R.; Ralston, R. W.; Harman, T. C.; McVittie, J. P. (Massachusetts Inst. of Tech., Lexington). Appl. Phys. Lett.; 23: No. 11, 620-622(1 Dec 1973).

Single heterojunction diode lasers in the $Pb_{1-x}Sb_xTe$ alloy system were fabricated by low-temperature vacuum deposition of n-PbTe on a p-$Pb_{0.88}Sn_{0.12}Te$ substrate. The lasers have lower threshold current densities and operate cw at higher temperatures than homojunction devices in this material. At laser threshold the incremental diode resistance drops abruptly from 0.5 Ω to a series resistance limited value of 0.08 Ω, a previously unobserved effect in diode lasers which indicates very high internal quantum efficiency. (auth)

18503 DIFFUSION BATTERIES AND THEIR APPLICATION TO DETERMINING THE GRANULOMETRIC DISTRIBUTION OF RADIOACTIVE AEROSOLS. Renoux, A. (Brest Univ., France); Mouden, A.; Madelaine, G. Radioprotection; 8: No. 3, 219-228 (1973). (In French).

After a quick reminder of the different equations relating to rectangular diffusion batteries, a glimpse at the evolution of the main manufacturing techniques of these particle selector devices is given and the advantages and drawbacks of each are mentioned. A computation program is added as an appendix which will allow one to study the theories of possibilities of parallel plates diffusion batteries proceeding from the variation of the different parameters linked with the intercepting system. (FR)

18504 STUDY OF THE EFFECT OF XENON ON THE SIZE OF THE POPULATION INVERSION OF OSCILLATORY LEVELS OF THE CO_2 MOLECULE IN A DISCHARGE IN A MIXTURE OF CO_2 + He + Xe. Pugnin, V. I.; Sel'dmirov, I. M.; Senyutovich, E. G.; Tekuchev, A. N. Tr. Ryazan. Radiotekh. Inst.; No. 37, 69-77(1972). (In Russian).

The effect of adding Xe on the amplification of a CO_2 gas discharge laser was studied. The degree of amplification was recorded as a function of the quantity of Xe and the electrical characteristics of the discharge. It is suggested that the effect of Xe on the population inversion occurs through the change of the electrical characteristics of the discharge: the temperatures and concentrations of electrons. (Referativnyi Zh.)

18505 NECESSARY AND SUFFICIENT CONDITIONS FOR THE FORMATION OF AN INVERSION IN GAS LASERS. Doronin, V. G.; Ostapchenko, E. P. Tr. Ryazan. Radiotekh. Inst.; No. 37, 18-27 (1972). (In Russian).

The conditions for the formation of a population inversion in a gas laser are examined with the aid of radiation from other channels of oscillation. The possibility of creating an inversion by optical pumping or external radiation corresponding to transitions in these channels is demonstrated. Conditions are found under which additional gas has a positive effect on obtaining an inversion in a gas laser. (Referativnyi Zh.)

18506 EVALUATION OF THE MODAL COMPOSITION OF RADIATION FROM GAS LASERS USING THE SPATIAL COHER-

ENCE FUNCTION. Zabortseva, T. A.; Stepanov, A. F.; Stepanov V. A. Tr. Ryazan. Radiotekh. Inst.; No. 37, 56-62(1972). (In Russian).

The spatial coherence function of gas laser radiation $|\gamma_{12}| \times$ was studied experimentally in a Young interferometer for two experimental geometries (symmetrical and asymmetrical). The object of the investigation was an Ar laser (λ = 514.5 nanometers) with a confocal resonator (base about 0.8 meters), the control of the oscillation mode being achieved by alignment of the resonator mirror. It was shown that $|\gamma_{12}| \times$ functions can be used to calculate the ratio of power of the generated modes, with the values the same in the two geometries. For two lines of a He–Ne laser (632.8 and 640.1 nanometers) the distribution of energy in cross sections of the beam in the near zone and the spatial coherence functions $|\gamma_{12}| \times$ were studied as the length of the resonator approached the critical ($R_1 = \infty$, R_2 = 1 meter, L → meter). It was shown that the $|\gamma_{12}| \times$ functions give more accurate information about the modal composition of the radiation than data on the distribution of energy in the cross section of the beam. (Referativnyi Zh.)

18507 LASER MIRROR DAMAGE IN GERMANIUM AT 10.6 μm. Emmony, D. C.; Howson, R. P.; Willis, L. J. (Loughborough Univ. of Tech., Eng.). Appl. Phys. Lett.; 23: No. 11, 598-600 (1 Dec 1973).

Damage in the germanium output mirror of a TEA CO_2 laser shows a periodicity of 10.6 μm, the laser wavelength. A mechanism is proposed in which scattered and cavity radiation interfere. An interference mechanism is confirmed by experiments outside of the laser cavity. Periodic damage is obtained in thin films irradiated at angles other than the normal where the fringe spacing is modified. (auth)

18508 TUNABLE COHERENT VACUUM-ULTRAVIOLET GENERATION IN ATOMIC VAPORS. Hodgson, R. T.; Sorokin, P. P.; Wynne, J. J. (IBM Watson Research Center, Yorktown Heights, NY). Phys. Rev. Lett.; 32: No. 7, 343-346(18 Feb 1974).

Two tunable dye lasers were used to generate coherent radiation at a tunable sum frequency in the vacuum-ultraviolet spectral region. Spectral ranges of ~3500 cm^{-1} around 1895 Å and ~1200 cm^{-1} around 1798 Å were covered. These ranges may easily be extended. Large ($\sim \times 10^4$) enhancements of $2\nu_1 + \nu_2$ sum mixing are seen when $2\nu_1$ is tuned to a double-quantum allowed transition from the ground state in Sr vapor. (auth)

18509 METHOD AND APPARATUS FOR PRODUCING ISOLATED LASER PULSES HAVING A FAST RISE TIME. Tomlinson, R. G. (to United States Atomic Energy Commission). US Patent 3,820,038. 25 Jun 1974. Filed date 9 Feb 1973. 6p.

A laser oscillator system is described which provides laser pulses having a characteristically short rise time and high energy content. A laser oscillator is Q-switched to produce short duration pulses of radiation and a small amount of each pulse is tapped off to trigger a spark gap discharge in an electro-optic modulator. A pair of polarizing elements and the modulator are located along the axis of the optical cavity in the oscillator. With selective activation of the modulator, the polarizer elements interrupt the resonant reflections of the optical flux between the mirrors defining the oscillator and the Q-switched pulse energy is rapidly dumped from the cavity as fast rise time pulses. (Official Gazette)

18510 MULTISIDED ELECTRON BEAM EXCITED ELECTRICALLY PUMPED GAS LASER SYSTEMS. Stapleton, R. E.; Hunter, R. O. Jr. (to United States Atomic Energy Commission). US Patent 3,818,375. 18 Jun 1974. Filed date 27 Mar 1973. 6p.

A gas laser amplifier system is described that has a plurality of pumping chambers spaced around the circumference of a vacuum chamber which has disposed within it an electron gun system which produces a plurality of electron beams. The electron beams are sufficiently energetic and so directed that they produce substantial ionization through the entire volume of gaseous lasing medium that is to be electrically pumped in each pumping chamber. The system is adapted for use with lasing media at atmospheric pressure and above and is particularly useful with He–N_2–CO_2 gas mixtures. (Official Gazette)

18511 METHOD OF FOCUSING A HIGH-POWERED LASER BEAM. Watt, B. E. (to United States Atomic Energy Commission). US Patent 3,817,604. 18 Jun 1974. Filed date 3 Jan 1973. 6p.

A method is described for providing a focal spot position independent of the input optical power of a laser beam. A negative lens is interposed such that focal spot motion caused by a changing refractive index in one lens element is canceled by an opposing motion in the negative lens element. (Official Gazette)

18512 SYNCHRONOUSLY DRIVEN Q-SWITCHED OR Q-SWITCHED-MOLE-LOCKED LASER OSCILLATOR. Johnson, B. C.; Steinmetz, L. L. (to United States Atomic Energy Commission). US Patent 3,815,046. 4 Jun 1974. Filed date 7 Feb 1973. 6p.

A laser oscillator is described for producing relatively long duration Q-switched or Q-switched/mode-locked bandwidth-limited pulses. The oscillator is self-driven and then synchronously gated at the cavity round trip time, whereby a large pulse of noise light of controllable duration is allowed to build-up by means of controlled bandwidth feedback. (Official Gazette)

18513 CRYSTAL STRUCTURE AND FLUORESCENCE LIFETIME OF A LASER MATERIAL $NdNa_5(WO_4)_4$. Hong, H. Y. P.; Dwight, K. (Massachusetts Inst. of Tech., Lexington). Mater. Res. Bull.; 9: No. 6, 775-780(Jun 1974).

The structure of $NdNa_5(WO_4)_4$, determined by single-crystal x-ray analysis, is tetragonal with space group $I\,4_1/a$ and cell parameters a = 11.559(2) Å, b = 11.453(2) Å, z = 4. A full-matrix, least-squares refinement gives R = 0.077. The W atoms and the Nd atoms occupy isolated tetrahedra and dodecahedra, respectively. These polyhedra are connected by the Na atoms, which are located at two different sites, tetrahedral and octahedral. The fluorescence lifetime of the $^4F_{\frac{3}{2}} \rightarrow {}^4I_{\frac{9}{2}}$ transition of Nd^{+3} is reported for the system $La_{1-x}Nd_xNa_5(WO_4)_4$. The lifetime of $NdNa_5(WO_4)_4$ is 85 ± 5 μsec, which is comparable to NdP_5O_{14}. Concentration quenching is considerably reduced in both host structures, which is concluded to be due to the isolation of the rare-earth polyhedra. (auth)

18514 DOUBLE-DISCHARGE COPPER VAPOR LASER WITH COPPER CHLORIDE AS A LASANT. Chen, C. J.; Nerheim, N. M.; Russell, G. R. (Jet Propulsion Lab., Pasadena, CA). Appl. Phys. Lett.; 23: No. 9, 514-515(1 Nov 1973).

A copper vapor laser utilizing copper chloride as a lasant in a heated discharge tube has been studied. The lasing action was observed only when two successive discharge current pulses at suitable time intervals were applied. The first pulse is considered to be a dissociation pulse to produce copper and chlorine atoms; the second to be a pumping pulse to produce population inversion. The maximum energy density measured to date was 17 $\mu J/cm^3$. (auth)

18515 Q SWITCHING A CO_2 LASER BY A PLASMA. Box, S. J.; John, P. K. (Univ. of Western Ontario, London). J. Appl. Phys.; 44: No. 11, 5167-5168(Nov 1973).

A transversely excited pulsed CO_2 laser is Q switched by means of a plasma. The plasma was produced in an electromagnetic shock tube and was used to cut off the trailing edge of the laser pulse at a predetermined time and Q switch the rest. Up to an order-of-magnitude relative increase in power is obtained for the Q switched portion of the output. (auth)

18516 STUDY OF EXCITATION TRANSFER IN LASER DYE MIXTURES BY DIRECT MEASUREMENT OF FLUORESCENCE LIFETIME. Lin, C.; Dienes, A. (Univ. of California, Berkeley). J. Appl. Phys.; 44: No. 11, 5050-5052(Nov 1973).

By directly measuring the donor fluorescence lifetime as a function of acceptor concentration in the laser dye mixture rhodamine 6G–Cresyl violet, it was found that the Stern-Volmer relation is obeyed, from which the rate of excitation transfer is determined. The experimental results indicate that the dominant mechanism responsible for the efficient excitation transfer is that of resonance transfer due to long-range dipole–dipole interaction. (auth)

18517 CARRIER AND GAIN SPATIAL PROFILES IN GaAs STRIPE GEOMETRY LASERS. Hakki, B. W. (Bell Telephone Labs., Inc., Murray Hill, NJ). J. Appl. Phys.; 44: No. 11, 5021-5028(Nov 1973).

The spontaneous emission generated in the active region of stripe geometry GaAs double-heterostructure (DH) laser diodes is observed through the n-GaAs substrate. The spatial variation of the spontaneous intensity along the junction plane is measured in a direction normal to the stripe axis at current levels below and above lasing threshold. It is observed that the carrier concentration profile is consistent with a model in which carriers out diffuse along the junction plane away from the active region. No evidence has been found of a local depletion of carrier concentration due to regenerative optical oscillations. Analytical expressions for the concentration profiles are obtained from a diffusion model. A comparison of the analytical expressions with experiment yields the carrier diffusion lengths inside and outside of the active region. The computed profiles are in excellent agreement with measurement. From the computed carrier concentration profiles and measurements of mode gain dependence on current it is possible to obtain the spatial variation of local gain in the active region. Coupling of the fundamental optical mode to this nonuniform gain distribution reduces the electronic gain. The lasing threshold of the fundamental mode in the stripe geometry laser is shown analytically to increase as the stripe width is decreased relative to a

carrier diffusion length. Finally, the gain dependence on current density has been evaluated and shown to be in agreement with analytical results based on band-to-band recombination in lightly doped active regions. (auth)

18518 POLARIZATION OF THE RADIATION OF SINGLE-MODE GAS LASERS WITH ANISOTROPIC RESONATORS, OPERATING ON J-J TRANSITIONS. Melikhin, G. V. Tr. Ryazan. Radiotekh. Inst.; No. 37, 5-10(1972). (In Russian).

An analysis is given of the polarization characteristics of single-mode gas lasers operating on the J-J transition. It is noted that threshold oscillations in the resonator with an amplitude anisotropy are linearly polarized and that the plane of polarization is determined by the direction of least loss. When the intensity of radiation is increased to some critical value determined by the parameters of resonator anisotropy and the characteristics of the active medium, a linear polarization is observed; when the intensity is further increased, the polarization changes almost to circular. The conditions for observing elliptical polarization of the radiation are cited, and the relationship between the direction of plane polarization and the adjustment of the resonator and the intensity of the radiation are given. (Referativnyi Zh.)

18519 STABILITY BOUNDARIES FOR TWO-MODE LASERS IN THE STRONG-COUPLING LIMIT. Texter, J. A. (Lafayette Coll., Easton, PA); Bergmann, E. E. Phys. Rev., A; 9: No. 6, 2649-2651(Jun 1974).

Criteria are presented for determining what field fluctuations are required to cause a bistable two-mode laser to flip from one mode to the other. Results (for a particular two-mode model) generated numerically are presented. Extensions of the method to more refined two-mode models and multimode cases are discussed. (auth)

18520 MODIFICATIONS TO THE SCULLY–LAMB LASER MASTER EQUATION. Carmichael, H. J.; Walls, D. F. (Univ. of Waikato, Hamilton, New Zealand). Phys. Rev., A; 9: No. 6, 2686-2697(Jun 1974).

A quantum theory of the laser is presented in which the coupling between atoms and field is retained in the treatment of the irreversible behavior of the atoms. A master equation for the optical field is obtained and compared with that resulting from the laser theory of Scully and Lamb, where atom-field correlations are neglected in describing the relaxation of the atoms. It is confirmed that for laser powers currently available the approximation employed by Scully and Lamb is valid. (auth)

18521 MOLECULAR-HYDROGEN LASER: 1098-1613 A. Dreyfus, R. W.; Hodgson, R. T. (Thomas J. Watson Research Center, Yorktown Heights, NY). Phys. Rev., A; 9: No. 6, 2635-2648(Jun 1974).

A 4-GW electron beam was used to excite amplified spontaneous emission in hydrogen isotopes (ortho and para H_2, HD, and D_2). The laser energy was measured with photodiodes, an ionization chamber, and film, and these different measurements are compared in detail. Analysis of the laser energy indicates the spectral linewidths is due to Doppler broadening, and, consequently, cooling the gas produces higher gain and power. This additional gain allows lasing to be observed at even shorter wavelengths (1098 Å as compared to 1161 Å) than reported previously. Also many (stimulated emission) spectral lines of the Werner and Lyman bands are reliably identified for the first time. (auth)

18522 THEORY OF PLASMA ELECTRON CONTRIBUTION TO THE ELECTRON-BEAM-EXCITED NITROGEN LASER. McArthur, D. A.; Poukey, J. W. (Sandia Labs., Albuquerque, NM). Phys. Rev. Lett.; 32: No. 3, 89-92(21 Jan 1974).

A new and experimentally verified model of gas laser excitation by relativistic electron beams is described. It is shown that in the pressure range 1–50 torr N_2 nearly all the excitation of the 3371-Å nitrogen laser is caused by low-energy plasma electrons (and not by primary or cascade electrons). (auth)

18523 THEORY OF THE GASODYNAMIC LASER WITH A BINARY MIXTURE. Vasilik, N. Ya.; Margolin, A. D.; Margulis, V. M. Zh. Prikl. Mekh. Tekh. Fiz.; No. 3, 23-30(1974). (In Russian).

A numerical calculation of the oscillation relaxation of binary mixtures of molecular nitrogen and carbon dioxide was made for all intervals of concentration changes and for a wide range of pressures, temperature of the mixture, and geometry of the supersonic part of nozzle (dimension of the critical cross section and degree of expansion). It was shown that within the parameter changes studied for the mixture and nozzle there is an inverse population density of the molecules. The change of the inverse population density of the oscillating levels and the amplification factor of the gaseous mixture were calculated as a function of the parameters studied and the distance from the critical cross section of the nozzle. The energy characteristics of the gasodynamic laser were optimized. (tr-auth)

18524 PERFORMANCE AND CHARACTERISTICS OF A CHEMICAL CO LASER. Ultee, C. J.; Bonczyk, P. A. (United Aircraft Research Labs., East Hartford, CT). IEEE (Inst. Elec. Electron. Eng.), J. Quant. Electron.; QE-10: No. 2, 105-110(Feb 1974).

A cw transverse-flow chemical CO laser based on the $CS + O \rightarrow CO + S$ (+75-kcal/mole) reaction was studied. Power output is 4.5 W with a gas flow of 70 l/min at 5.4 torr. The output occurs in the 3-2 to 14-13 vibrational transitions. Gain measurements were made for a number of lines. The maximum observed gain coefficient is 0.006 cm^{-1}. The variation of the laser output with a number of parameters including the distance between CS_2 injection and the optical cavity axis is also reported. (auth)

18525 PULSE EVOLUTION IN MODE-LOCKED QUASI-CONTINUOUS LASERS. New, G. H. C. (Queen's Univ., Belfast). IEEE (Inst. Elec. Electron. Eng.), J. Quant. Electron.; QE-10: No. 2, 115-124(Feb 1974).

Various models of a passively mode-locked quasi-continuous laser are discussed and the evolution of pulses in various cavity configurations is traced. In certain circumstances, the combined action of amplifier and absorber saturation is shown to lead to rapid pulse compression even when the pulse duration is far shorter than the relaxation time of either nonlinear component. The results are in good agreement with recent streak-camera measurements involving the pulsed rhodamine 6G dye laser and satisfactorily explain the efficient generation of picosecond pulses in CW dye-laser systems. The same pulse-compression mechanism can probably be used to generate ultrashort pulses in other quasi-continuous lasers. (auth)

18526 GENERATION OF THE ROTATIONALLY SYMMETRIC TE_{01} AND TM_{01} MODES FROM A WAVELENGTH-TUNABLE LASER. Wynne, J. J. (IBM Watson Research Center, Yorktown Heights, NY). IEEE (Inst. Elec. Electron. Eng.), J. Quant. Electron.; QE-10: No. 2, 125-127(Feb 1974).

A nitrogen-laser-pumped dye laser was made to operate in the rotationally symmetric TE_{01} or TM_{01} modes. The modes are preserved as the laser wavelength is varied. The mode selector allows convenient switching from one mode to the other. The theory of the operation of the mode selector is described. (auth)

18527 CHAIN REACTION HCl CHEMICAL LASER. Emanuel, G. (to TRW Inc.). US Patent 3,818,374. 18 Jun 1974. Filed date 7 Mar 1973. 8p.

A chemical laser having good chemical efficiency and power level produced by chain reacting in an optical cavity chlorine gas with hydrogen or deuterium gas in a compact combustion driven chemical laser. An inorganic fluorine-source gas, an inorganic hydrogen-source gas, and an inorganic chlorine-source gas are introduced into the combustion chamber of a chemical laser whereupon the hydrogen-source gas and the fluorine-source gas react to heat the chlorine-source gas and produce atomic and diatomic chlorine. Atomic and predominantly molecular chlorine gas, together with the other combustion products, are driven into the laser cavity at supersonic velocities where the chlorine gas reacts with hydrogen or deuterium gas. In the laser cavity a chemical chain reaction takes place in which molecules of hydrogen or deuterium react with atomic chlorine to produce ground state hydrogen chlorine or deuterium chloride and atomic hydrogen or deuterium. The atomic hydrogen or deuterium, in turn, reacts with the molecular chlorine to produce the lasing species of hydrogen chloride or deuterium chloride and atomic chloride and atomic chlorine. Laser radiation is emitted from the laser cavity transversely to the flow of gases. (Official Gazette)

18528 ULTRA-FAST TERMINATOR FOR INTENSE LASER PULSES. Milam, D. (to Secretary of the Air Force). US Patent 3,814,503. 4 Jun 1974. Filed date 7 Feb 1973. 4p.

An ultra-fast terminator for laser pulses is provided in which plasma produced by firing a laser-triggered spark gap is used to speed and enhance the formation of a highly opaque plasma across the focal plane of a laser beam. The additional plasma contributed by the spark gap serves to prevent leakage of the beam past the plasma created by the laser itself. (Official Gazette)

18529 X-RAY LASER. Wood, L. L. (to United States Atomic Energy Commission). US Patent 3,823,325. 9 Jul 1974. Filed date 23 Jul 1973. 4p.

An x-ray laser is described that uses rapid flash heating of a filament of intermediate Z material to temperatures of the order of the K-shell binding energy of the material. (Official Gazette)

18530 OPTIMUM CONDITIONS FOR OPERATION OF A PASSIVE SHUTTER IN A LASER. Ivanov, V. A.; Kovalev, A. A.;

Lebedev, V. I. Zh. Prikl. Spektrosk.; 20: No. 4, 597-600(Apr 1974). (In Russian).

The dependence of the monopulse energy in a laser with a passive shutter on the ratio of the power density at the shutter and the active element was studied. It was shown that there are optimum conditions for operation of a passive shutter in relation to its discharge which determines the dependence of the output energy of the monopulse on the ratio of the forced transfers in the material of the filter and the ruby and on the thermal effect originating in the substance of the filter under the action of the radiation. Agreement between the experimental and calculated data was shown. (tr-auth)

18531 DEPENDENCE OF NONLINEAR BOND OF LASER RING ON MODE POLARIZATION. Apanasevich, P. A.; Dubovets, V. G. Zh. Prikl. Spektrosk.; 20: No. 4, 612-618(Apr 1974). (In Russian).

Theoretical studies were made on the effect of mode polarization on the nonlinear bond between modes of a cyclic laser resulting from dispersion of waves on a diffraction lattice, induced by generation radiation. Resonance transition was modeled by joining chaotically oriented linear (type $\Delta J = 0$ transitions) or curved ($\Delta J = \pm 1$) of dipoles. In calculating the polarization of the active medium in the approach of strong collisions, the redistribution of active atoms according to rate and to orientation was considered. It was shown that the nonlinear bond between waves through dispersion, as with competition, of oscillations depends on the polarization state of the interacting mode. It is maximum when the interacting waves are polarized the same and the type of polarization corresponds to the type of transition dipole. With orthogonal polarization of the waves it is minimum but is never converted to zero. (tr-auth)

18532 ENERGETIC CHARACTERISTICS OF COMPETING TRANSITIONS IN He-Ne LASERS WITH THE ACTIVE MEDIUM LOCATED IN A MAGNETIC FIELD. Voitovich, A. P.; Shkadarevich, A. P. Zh. Prikl. Spektrosk.; 20: No. 4, 606-611(Apr 1974). (In Russian).

The effect of a magnetic field on competing transitions at wavelengths 1080 and 1198 μm in He-Ne lasers was studied. The dependence of the rate of generation at these transitions, W, on the magnetic field strength, H, in lasers with either isotropically polarized resonance or with Brewster plates in the resonator was investigated. W(H) in the first case depended chiefly on plasma effects and in the second, on the Zeeman splitting of the force shapes. The competition at low magnetic strengths corresponding to dual optical resonance was studied, and g factors were found for the $2p_1$ and $2p_7$ levels in neon. Hysteresis occurring with shift in the laser operation from generation at one to generation at both related transitions was studied. (tr-auth)

18533 PHYSICAL PROPERTIES OF A SOLVENT FOR STABLE LASER PASSIVE SHUTTERS. Gryaznov, Yu. M.; Kirsanova, T. I.; Savelova, V. K. Zh. Prikl. Spektrosk.; 20: No. 4, 716-717(Apr 1974). (In Russian).

The state of a solvent ($AlBr_3 + CH_3COCl$), used in laser technology for making a stable illuminating and darkening passive shutters of phthalocyanine dyes is discussed. Some physical properties of these solvents are given. (tr-auth)

18534 CHEMICAL LASER AMPLIFICATION PROPERTIES OF A UNIFORM, TURBULENT MIXING LAYER OF FLUORINE AND HYDROGEN. Shu, H. T. Chicago; University of Illinois (1973). 98p. University Microfilms Order No. 74-4649.

Thesis (Ph. D.).

The laser amplification properties of a turbulent mixing layer generating population inversion by chemical reactions of fluorine and hydrogen are analyzed. In order to elucidate the basic aspects of this complicated problem, it is considered that two streams of equal mean velocity of fluorine and hydrogen, respectively, are made turbulent at a given point. The two streams are then allowed to mix downstream and to initiate the chemical reactions which generate the various inverted vibrational states of HF molecules. These pumping reactions, which are coupled to the collisional deactivation reactions and to the laser radiation field normal to the flow direction, are assumed to be infinitely fast. The first four vibrational levels of the HF molecules are considered in the present analysis. This problem is analyzed by the use of the simplified statistical theory developed by Chung earlier. Application of the theory to the problem results in a set of hyperbolic partial differential equations in the two space coordinates. Solution of the equations is obtained by the method of characteristics. Various sums of the chemical and thermal energies and the mass shared among the reaction partners are found to be the properties which propagate along two of the three characteristics. These are invariants except for the dissipative process and the collisional and radiative deactivation processes. Mean laser gain coefficients as well as the other mean quantities pertinent to the amplification properties are found to be critically dependent on the Damkohler numbers. The nonlinear characteristics of the interactions between the turbulence, chemical, and radiation properties of the mixing layer affecting the overall performance are delineated. (Diss. Abstr. Int., B)

Heat Transfer and Fluid Flow

Refer also to abstracts 18680, 20357, and 20377.

18535 (ORO-3936-12) VAPOR EXPLOSION: HEAT TRANSFER AND FRAGMENTATION. Final Report. Witte, L. C.; Cox, J. E. (Houston Univ., Tex. (USA). Dept. of Mechanical Engineering). Mar 1974. Contract AT(40-1)-3936. 16p. Dep. NTIS $4.00.

This final report describes work performed during a 4½ year period concerning rapid vapor formation. Experimental and theoretical results are discussed briefly. The present state-of-understanding of the vapor explosion phenomenon is presented. A complete listing of reports, theses, dissertations and published papers resulting from the contract is given. (auth)

18536 (RLO-2227-T4-4) NATURAL CONVECTION HEAT TRANSFER IN LIQUID METALS. Progress Report, January 1, 1973-December 31, 1973. Welty, J. R. (Oregon State Univ., Corvallis (USA). Dept. of Mechanical Engineering). Dec 1973. Contract AT(45-1)-2227. 48p. Dep. NTIS $5.50.

Research progress for the reporting period is reported on: (1) natural convection studies in mercury confined between two vertical heated pipes, and (2) natural convection heat transfer studies in mercury adjacent to a vertical cylinder with constant heat flux. A bibliography of publications developed on the project for prior years is presented. (TFD)

18537 THERMOELASTIC BEHAVIOR OF A CYLINDRICAL SHELL SUBJECTED TO AN INSTANTANEOUS HOT SPOT. I. The Case of an Instantaneous Plane Hot Spot. Shirakawa, K. (Osaka Prefectural Univ.). Nippon Kikai Gakkai Rombunshu; 39: No. 322, 1764-1770(Jun 1973). (In Japanese).

Many reports have been presented on the study of thermal stress due to an instantaneous hot spot, in relation to spot welding, the heat generation inside nuclear reactors, etc. The solution of the problems of thermal stress due to an instantaneous hot spot can be widely utilized to many practical cases. The solution of a thermal conduction equation and the derivation of the equations for thermal deformation and thermal stress on the basis of temperature distribution are described for the case in which an instantaneous plane hot spot occurs at any place of a cylindrical shell. Considering the case in which the instantaneous plane hot spot occurs at the center of a shell, the temperature distribution was calculated, and the changes in the deflection in a heated part and in an unheated part, and in the deflection, membrane stress and bending stress in the circumferential direction were examined. The deflection and stress in a circumferential cross section in the neighborhood of a hot spot were in a converse direction to those in the hot spot. This is considered to be one of the reasons for the thermal fatigue of structure. (JA)

18538 FORCED CONVECTION HEAT TRANSFER TO BOILING HELIUM IN A TUBE. Ogata, H.; Sato, S. (Hitachi Ltd., Tokyo). Cryogenics; 14: No. 7, 375-380(Jul 1974).

A study carried out to obtain the heat transfer characteristics of liquid helium 1 in a vertical tube under forced convection conditions is described. The test section was a straight stainless-steel tube with a length of 8.5 cm and an i.d. of 0.109 cm. Helium pressures ranged from 1.1 to 1.9 atm and qualities (vapor mass fractions) ranged from zero to 1. Results were correlated using conventional equations and compared with data already obtained. The hysteresis observed in the nucleate boiling region is qualitatively discussed. The quality dependence of two-phase flow heat transfer was clearly observed during an increase, but not during a decrease, of heat flux or quality. (auth)

18539 ACOUSTIC EMISSION. II. Manaranche, J. C. (Centre d'Etudes de Valduc, Is-sur-Tille, France). Mes., Regul., Automat.; No. 11, 81-84(Oct 1973). (In French).

Industrial applications of the method are presented with particular attention being given to the control of pressurized vessels in the nuclear industry. (FR)

18540 TWO-PHASE FLOW: THE CONCEPT OF SIMILARITY AND EQUIVALENT TRANSPORT PROPERTIES OF FLUIDS. Nguyen, V. T.; Spedding, P. L. A.I.Ch.E. (Amer. Inst. Chem. Eng.) J.; 19: No. 3, 652-655(May 1973).

Dukler, Moye, Wicks, and Cleveland in 1964 developed as similarity concepts for two-phase flow, the two-phase Reynolds number and the two-phase Euler number in terms of two empirical

dimensionless constants C_1, C_2. Dukler, et al., and others have shown experimentally that $C_1 = C_2 = 1.0$. In the present paper, it is shown analytically that this should be so for two-phase symmetrical systems. The concept of a symmetrical system is also discussed. (Appl. Mech. Rev.)

18541 AUTORADIOGRAPHIC METHOD OF PLOTTING FLOW PATTERNS IN BOUNDARY LAYERS. Treutler, H. C.; Freyer, K.; Hartmann, G. (Zentralinstitut fuer Isotopen- und Strahlenforschung, Leipzig). Isotopenpraxis; 10: No. 5, 179-181(May 1974). (In German).

An autoradiographic method providing non-contact determination of liquid flow patterns in boundary layers is described. With the aid of some suitable arrangement of radioactive nuclide is added to the flowing liquid in order to trace its way on the surface of the body in the vicinity of which the flow conditions are to be investigated. The thus arising activity distribution throughout the surface is by autoradiography transformed into a balckening plot which is due to evaluation. This autoradiograph supplies local flow directions as well as in certain cases, local flow velocities. (auth)

18542 EXPERIMENTAL STUDY OF HEAT TRANSFER IN DECELERATING FLOW IN AN ANNULUS. Ichimiya, K. (Kyushu Univ., Fukuoka); Hasegawa, S.; Tani, Y.; Kusumoto, S. Heat Transfer–Jap. Res.; 3: No. 1, 80-92(1974).

Heat transfer experiments were carried out in a diverging concentric annular passage with decelerating flow. Locations of maximum and minimum local heat transfer coefficients were defined. A comparison with straight-annulus data was made. The effect of the angle of divergence was determined. (auth)

18543 EFFECT OF A HEAT FLUX SPIKE ON THE DOWNSTREAM DRYOUT BEHAVIOR. Groeneveld, D. C. (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Heat Transfer; 96: No. 2, 121-125(May 1974).

From ASME-AIChE heat transfer conference; Atlanta, GA (5 Aug 1973).

The effect of a short hot patch on the downstream dryout behavior was investigated in heated tubes cooled by Freon-12 at conditions equivalent (on the basis of liquid to vapor density ratio) to 69 bar in steam-water. The hot patch, located well upstream from the heated end, generated a heat flux spike which resulted in a local dry patch. Following an increase in downstream surface heat flux the dry patch would often spread in the downstream direction even though the heat flux was only a small fraction of the measured critical heat flux with uniform heating. A force balance on the dry patch boundary showed that, for certain conditions, spreading of the dry patch in the downstream direction is inevitable. This spreading, however, can be limited by interfacial instability, droplet-wall interaction and axial conduction. (auth)

18544 ANALYSIS OF TRANSIENT TURBULENT HEAT TRANSFER IN AN ANNULUS. I. Heating Element with a Finite (Nonzero) Heat Capacity and No Thermal Resistance. Kawamura, H. (Japan Atomic Energy Research Inst., Tokai). Heat Transfer–Jap. Res.; 3: No. 1, 45-68(1974).

Transient turbulent heat transfer in an annulus has been analyzed, using a core tube with a finite thermal capacity and no thermal resistance. Heat generation in the core tube was increased stepwise with time. The flow was steady and fully developed. Numerical solution of the transient energy equation shows that the heat transfer coefficient increases rapidly and then decreases asymptotically to its steady state value. An analytical solution of the transient conduction equation for the turbulent flow was obtained. The effects of flow conditions, heating tube thermal capacity, and initial heat generation rate were studied. When the heat generation is initially nonzero, there appears a maximum in the variation of the heat transfer coefficient. Accuracy of the quasi-state calculation of transient heat transfer is also discussed. (auth)

18545 CYLINDERS IN AXI-SYMMETRIC AIRFLOW. Effect of Flow Separation on Heat Transfer Rates. Chantrill, D. (Hong Kong Polytechnic). J. Inst. Nucl. Eng.; 15: No. 3, 74-78; 82-85 (May 1974).

An experimental investigation ascertaining local and average heat transfer rates from a cylinder fitted with a single radial projection has been conducted for the case of axi-symmetric flow in a subsonic airstream. The effect of projection size and Reynolds number on the heat transfer rates has been studied, and additionally measurements of velocity, temperature and turbulence levels made to determine if any correlation with the heat transfer results existed. Deductions concerning the separated flow structure were made on the basis of the experiments and these were confirmed by the results of flow visualization studies. It was found that separating the flow had the effect of increasing the overall heat transfer rate. Increases of up to 130% relative to the equivalent attached flow were possible. Local zones of reduced heat transfer were found to exist, giving rise to the possibility of using flow separation as a means of reducing overall heat transfer rates. The smallest projection produced the maximum overall heat transfer rate. The heat transfer results were seemingly consistent with the results of velocity, temperature, turbulence and visualization studies. (auth)

18546 AUGMENTATION OF HEAT TRANSFER IN TUBES BY USE OF MESH AND BRUSH INSERTS. Megerlin, F. E. (Linde AG, Aschaffenburg, Ger.); Murphy, R. W.; Bergles, A. E. J. Heat Transfer; 96: No. 2, 145-151(May 1974).

Results are summarized of a study to determine the heat transfer and pressure drop characteristics of two types of tube inserts developed specifically for augmenting heat transfer and accommodating high heat fluxes. The best performing mesh-insert tubes exhibited heat transfer coefficients nine times the coefficients with empty tubes while brush-insert tubes had coefficients averaging five times the empty tube values, both comparisons being made at equal mass velocity. Both inserts produced very large pressure drops. Subcooled boiling curves and burnout points are presented; burnout heat fluxes are two to three times the empty tube values at equal mass velocity. For single-phase conditions and for burnout, the mesh and brush tubes have favorable performance characteristics, based on pumping power, which suggest use of these inserts in certain special cooling systems. (auth)

18547 THEORETICAL MODEL OF THE MIXTURE-VAPOR TRANSITION POINT OSCILLATIONS ASSOCIATED WITH TWO-PHASE EVAPORATING FLOW INSTABILITIES. Wedekind, G. L.; Beck, B. T. (Oakland Univ., Rochester, MI). J. Heat Transfer; 96: No. 2, 138-144(May 1974).

A horizontal tube evaporator in which complete vaporization takes place can be divided into three distinct regions—a subcooled, a two-phase, and a superheat region. The mixture-vapor transition point corresponds to the liquid film dryout point, and when entrainment is negligible, it represents the boundary between the two-phase and superheat regions. Experimental evidence indicates that during what is conventionally accepted as steady flow conditions, the motion of the mixture-vapor transition point is of an oscillatory nature. Furthermore, not only are the oscillations random, but their statistical characteristics can be represented by a modified Rayleigh distribution. The formulation of a theoretical model which incorporates various deterministic mechanisms, and, at the same time, includes the existence of a random phenomenon is presented. The model has the capability of predicting the influence of evaporator heat flux and inlet flow quality on the statistical characteristics of the transition point oscillations. Perhaps, the most significant potential of the proposed model is that it represents a first step toward the formulation of some of the fundamental mechanisms associated with two-phase evaporating flow instabilities on a statistical basis; a basis which appears to be consistent with many of the experimental observations currently available. (auth)

18548 SEM STUDY OF NUCLEATION SITES IN POOL BOILING FROM 304 STAINLESS STEEL. Nail, J. P. Jr. (Chicago Bridge and Iron, Birmingham, AL); Vachon, R. I.; Morehouse, J. J. Heat Transfer; 96: No. 2, 132-137(May 1974).

A Scanning Electron Microscope (SEM) was used to examine pool boiling nucleation sites on 304 stainless steel in contact with distilled, degassed water. Nucleation sites were located during the boiling process by noting the coordinates of the bubble locations on the surface. These locations were then magnified using the SEM and photographs made of the nucleation sites. The radii of the cavities varied from 14.8μ-in. to 180μ-in. and the widths of grooves varied from 75μ-in. to 154μ-in. (auth)

18549 COOLING OF A VERY HOT VERTICAL SURFACE BY A FALLING LIQUID FILM. Sun, K. H. (General Electric Co., San Jose, CA); Dix, G. E.; Tien, C. L. J. Heat Transfer; 96: No. 2, 126-131(May 1974).

From ASME winter annual meeting; Detroit, MI (11 Nov 1973).

The cooling of a very hot vertical surface by a falling liquid film is analyzed. An analytical model is developed to characterize this phenomenon in three distinctive regions: a dry region ahead of the wet front, a sputtering region immediately behind the wet front, and a continuous film region further upstream. The analysis leads to predictions of the wet front velocity, the sputtering length, and the temperature profiles with respect to the wet front. The heat transfer mechanisms are shown to be dependent upon two temperature parameters characterizing the initial wall temperature and the temperature range for sputtering, and two Biot numbers comparing the convective heat transfer in the liquid film region and the sputtering region with longitudinal heat conduction. The predictions are in good agreement with existing experimental results. (auth)

Materials Testing

Refer also to abstracts 18541 and 19251.

18550 CHARACTERISTICS OF ^{170}Tm SOURCE USED FOR RADIOGRAPHIC INSPECTION. Tsujimoto, T.; Yoshimoto, T.; Katsurayama, K. (Kyoto Univ.). Hihakai Kensa; 22: No. 12, 747-752(Dec 1973). (In Japanese).

The fundamental characteristics of ^{170}Tm gamma-rays for radiographic inspection of light materials and thin steels were studied. The ^{170}Tm gamma-ray energy spectrum consists of 0 to 1 MeV continuous bremsstrahlung radiation and gamma-radiation of 8, 54, and 84 keV. The radiographic contrast and fault sensitivity for steel were calculated from energy spectrum by using a computer. The results were compared with those estimated from the experimental observations and showed good agreement. (auth)

18551 FLAW INSPECTION SYSTEM OF LARGE PRESSURE VESSELS BY ACOUSTIC EMISSION TECHNIQUE. Watanabe, T.; Hashirizaki, S.; Arita, H. (Nippon Steel Corp., Tokyo). Hihakai Kensa; 22: No. 12, 757-766(Dec 1973). (In Japanese).

A new flaw inspection system was developed making use of the acoustic emission (AE) technique which has of late been attracting particular attention as a new nondestructive inspection technique. The principle, technological composition, hardware and software, of AE testing are discussed and an example given of its application to large pressure vessels. In more than ten cases in which pipes and pressure vessels were tested by this system, the presence of a flaw was confirmed by ultrasonic flaw detection with a success rate of more than 90%. The present system, when combined with the conventional nondestructive inspection method, can establish a highly sensitive and efficient new inspection system. Further, experimental work should be continued to improve the reliability of the AE technique and to make it applicable to equipment other than pipes and pressure vessels. (auth)

18552 STUDY OF THE EFFECTS OF GEOMETRICAL EXPOSURE CONDITIONS ON IMAGE QUALITY IN GAMMAGRAPHY. Charlet, G.; Nouvet, A. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 105, 16-33(Jan 1974). (In French).

The results of image quality tests carried out on three well defined types of emulsion are presented. The effects of geometrical factors on image quality were investigated. The French image quality norm NF.A 04-304 adopted by the International Welding Institute was used. The following emulsions were studied: Kodak Definix (moderately fast and Kodak M (slow) with ^{192}Ir; Structurix D4 with ^{60}Co radiation. The sources used were cylindrical and viewed lengthways. Four variable geometrical parameters are likely to affect image quality: diameter of the source; source/film distance; source/image quality indicator distance; and thickness of steel traversed. (FR)

18553 DETECTABILITY OF WELD DEFECT BY RADIOGRAPHIC TESTING. Kanno, A. (Ship Research Inst., Tokyo). Hihakai Kensa; 22: No. 8, 430-439(Aug 1973). (In Japanese).

The detectability of each kind of weld defect is discussed in relation to the characteristics of image quality meters at identification limit. The detectability of the cracks having bad effect upon structural strength was satisfactory when radiation was in parallel to the cracks, but the detectability decreased remarkably when the radiation inclined by finite angle test pieces. Therefore, in order to acquire a high crack detectability in radiographic testing, it is necessary not only to increase the identification factor of the image quality meters, but also to introduce radiation perpendicularly to test pieces, or it may be necessary to irradiate in the direction of cracks. The regulation of JIS that the identification factor of linear image quality meters must be 2% affords high image quality in thin plates, but brings about low quality in thick plates with thickness more than 20 mm. It is necessary to reexamine the regulation of identification factor and the identification factor should be in relation to the thickness of test pieces. The detectability limit of blowholes and the dimensions of uncounted holes of thick test plates must be examined. (JA)

18554 APPLICATION OF AUTORADIOGRAPHY FOR THE EXAMINATION OF THE COKING PROCESS. Siewierski, J.; Kolaski, H.; Firganek, H. (Inst. fuer Eisenforschung, Gliwice, Poland). Isotopenpraxis; 10: No. 5, 174-178(May 1974). (In German).

The autoradiographic method was applied to investigate the behavior of coal grains having different plastic properties during the coking process. The surface of coal grains ranging 2 to 3 mm in size were labeled by covering them with an organic glass layer containing ^{185}W. The labeled coal grains were mixed with other coal grains having a size of 0 to 3 mm. During the heating process, the labeled coal grains were deformed owing to the softening of the coal mixture. After coking, the samples were cut, ground and subjected to autoradiography. The changes in the distribution of radioactive matter which have been made visible through the autoradiographs of coked and non-coked tests cuts were analyzed. As a result, conclusions could be drawn about the development of processes running in the plastified coal mass. (auth)

18555 PROPERTIES OF RADIOGRAPHIC ^{170}Tm SOURCE. Sumiya, Y.; Anma, M. (Prefectural Industrial Research Inst., Shizuoka, Japan). Shizuoka-Ken Kogyo Shikenjo Hokoku; No. 17, 85-92(Jan 1973). (In Japanese).

The properties of radiographic ^{170}Tm source were studied and the following results obtained: (1) γ-ray dose rate of ^{170}Tm is very small and so ^{170}Tm is suitable for thin steel plates and light metals, (2) on the film contrast ^{170}Tm is inferior to x-ray but superior to ^{192}Ir and so for the radiography of plates having different thickness ^{170}Tm is superior to x-ray, (3) on the visibility of penetrometer ^{170}Tm is inferior to x-ray but superior to ^{192}Ir, and (4) the apparatus of ^{170}Tm is very small and so ^{170}Tm is suitable for narrow places in which the apparatus of x-ray cannot be brought. (auth)

18556 APPLICATION OF AUTORADIOGRAPHY TO THE INVESTIGATION OF NEW DOPING TECHNIQUES OF SEMICONDUCTOR MATERIALS. Wronski, W.; Walis, L. (Inst. of Nuclear Research, Warsaw). Isotopenpraxis; 10: No. 5, 170-173(May 1974).

The development of technology of new semiconductor devices requires fundamental studies of a number of phenomena taking place in semiconductors during the doping process or accompanying the doping process. These studies are concerned with the following problems: (1) diffusion of gold in silicon and the effect of diffusion layers (particularly phosphorus layers) and epitaxial silicon layers on the distribution of gold in thin silicon plates; and (2) distribution of admixtures in silicon introduced with the aid of the ion implantation technique. The studies concerned with the second of the above mentioned problems comprised an autoradiographic examination of the homogeneity of the beam of phosphorus ions implanted in silicon, and a study of some apparatus factors and of the purity of the basic material on the implantation. (auth)

18557 APPLICATION OF AUTORADIOGRAPHY TO THE EXAMINATION OF CHROMIUM DISTRIBUTION IN RUBIES. Cichomska, K.; Walis, L.; Kaczor, J. (Inst. of Nuclear Research, Warsaw). Isotopenpraxis; 10: No. 5, 165-169(May 1974).

One of the main causes of optical defects in ruby lasers is the segregation of chromium, which results in changes of the index of refraction and in divergence of the light beam. Here studies are being carried out, using the technique of contact autoradiography, on the segregation of chromium in ruby monocrystals obtained with the aid of Verneuille's method. The specimens for autoradiographic studies were activated in a nuclear reactor or labelled with ^{51}Cr (^{51}Cr-labelled γ-Al_2O_3). Autoradiograms of samples, cut out perpendicularly to the direction of growth and ruby monocrystals revealed the presence of concentration changes in the form of concentric rings. The autoradiography permits to carry out qualitative and quantitative evaluation of concentration changes of chromium. This technique can also be used for the examination of other optically active admixtures e.g., Nd. (auth)

18558 HIGH ENERGY RADIOGRAPHY. A New Technique in the Development of Efficiency and Integrity in Aero Gas Turbine Engines. Pullenm, D. A. W. (Atomic Energy Research Establishment, Harwell, Eng.). Atom (London); No. 212, 108-120(Jun 1974).

From national spring conference of the American Society for nondestructive testing; Los Angeles, CA (1973).

The project described is a result of collaboration between the Nondestructive Testing Center at AERE, Harwell, and the Rolls-Royce Bristol Engine Division, and involves the use of a linear accelerator, with its large output of high-energy x rays, for the radiography of aero gas turbine engines under running conditions, with a view to improving the design. The practical differences between radiography of a static and a running engine are examined. Some examples of engine radiographs obtained with this technique are shown, including the Olympus 593 for Concorde. The technique should be applicable to other forms of rotating machinery. (UK)

Nuclear Explosions

Refer also to abstracts 18652 and 18786.

18559 (AD-740845) NORSAR RESEARCH AND DEVELOPMENT. Period Covered: 1 July 1970-30 June 1971. Husebye, E. S. (Norges Teknisk Naturvitenskapelige Forskningsraad, Kjeller. NORSAR). Apr 1972. Contract F19628-70-C-0283. 47p. (NORSAR-23; ESD-TR-72-143). NTIS $3.00.

System developments and software debugging efforts are described. The establishment of organizational procedures required for the routine NORSAR operation and research aimed at system improvements and array performance evaluation are discussed. The most important single event in the reporting peroid was that the NORSAR array became operational in March 1971. (auth)

18560 (AD-755911) NORSAR RESEARCH AND DEVELOPMENT. Period Covered: 1 July 1971-30 Jun 1972. Husebye, E. S. (Norges Teknisk Naturvitenskapelige Forskingsraad, Kjeller. NORSAR). 15 Dec 1972. Contract F19628-70-C-0283. 24p. (NORSAR-50; ESD-TR-73-110). NTIS $3.00.

System developments and software debugging efforts and establishment of organizational procedures required for the routine NORSAR operation are presented. The research efforts were aimed at system improvements, especially to increase the event detection capability, and array performance evaluation. Work completed and in progress is discussed in Chapter II. The first five sections deal with event detection problems, while in the next four sections observed and predicted NORSAR event detection problems, while in the next four sections observed and predicted NORSAR event detection and location capabilities are discussed. Two studies on event classification problems are also included, and the last four sections cover structural investigations and long term noise variation investigations. The most important signal event in the reporting period was the seminar on Seismology and Seismic Arrays which took place in Olso, 22-25 Nov 1971. (auth)

18561 (AD-756846) FIELD MAINTENANCE REPORT. Technical Report, 1 January-30 September 1971. (Norges Teknisk Naturvitenskapelige Forskningsraad, Kjeller. NORSAR). 1 Oct 1972. Contract F19628-70-C-0283. 164p. (NORSAR-32; ESD-TR-72-394). NTIS $3.00.

Installation and field maintenance of the NORSAR array for the period 1 January-30 September 1971 are described. Although most of the equipment was installed by the start of the report period, some installation work and substantial testing remained to be done; this is reflected in the report. Also, results of a number of special tests, partly performed in earlier periods, are included in the report. (auth)

18562 (AD-756847) SYSTEM OPERATION REPORT. Period Covered: 1 January-30 June 1971. (Norges Teknisk Naturvitenskapelige Forskningsraad, Kjeller. NORSAR). 1 Nov 1972. Contract F19628-70-C-0283. 21p. (NORSAR-36; ESD-TR-73-101). NTIS $3.00.

Operation of the complete NORSAR system started in the beginning of 1971, following completion of electronic equipment installations. The first account of operation under assumed 'normal' conditions is presented. Some operational experience had already been gained from interim operation ('Plan D') and successive transfer of subarrays to fully operative status. The period was characterized by testing and running-in of the system. Efforts by NORSAR's regular staff, in cooperation with IBM were concentrated on optimizing the performance by debugging and improvements in the various fields, in particular with programming and optimizing the performance by debugging and improvements in the various field, in particular with programming and field equipment performance. (auth)

18563 (AD-756848) ARRAY MONITORING AND FIELD MAINTENANCE REPORT. Period Covered: 1 October 1971-30 June 1972. Steinert, O.; Nilsen, A. (Norges Teknisk Naturvitenskapelige Forskningsraad, Kjeller. NORSAR). 8 Nov 1972. Contract F19628-70-C-0283. 97p. (NORSAR-40; ESD-TR-73-102). NTIS $3.00.

The improvement, maintenance, and operation monitoring of NORSAR are taken care of by a department of the NORSAR project organization, headed by personnel at the NORSAR Data Center. The monitoring of the array performance is done remotely, at the Data Center, using a program package with a large number of on-line and off-line features. The field maintenance of the array, the remote array monitoring and their interaction are discussed. The routines for the maintenance and monitoring tasks, and the monitoring program package are described. (auth)

18564 (AD-756849) FIELD MAINTENANCE REPORT. Technical Report, 1 July-31 December 1970. (Norges Teknisk Naturvitenskapelige Forskningsraad, Kjeller. NORSAR). 1 Oct 1972. Contract F19628-70-C-0283. 25p. (NORSAR-31; ESD-TR-72-393). NTIS $3.00.

The NORSAR field activities for the period 1 July-31 December 1970 are described. The delayed equipment installation and check-out are discussed. (auth)

18565 (AD-759254) SYSTEM OPERATIONS REPORT, 1 January-30 June 1972. (Norges Teknisk Naturvitenskapelige Forskningsraad, Kjeller. NORSAR). 20 Feb 1973. Contract F19628-70-C-0283. 54p. (NORSAR-54; ESD-TR-73-141). NTIS $3.00.

The operation of the NORSAR system during the first half of 1972 is described. A short summary of maintenance center activities is presented. Improvements have been achieved in the traditionally problematic field of short period seismometers and amplifiers. (auth)

18566 (AD-761646) STUDY OF DIFFERENT METHODS OF CODING A CAPPED MODEL. Isenberg, I. (Agbabian Associates, El Segundo, Calif. (USA)). Jan 1973. Contract DNA001-72-C-0045. 43p. (AA-R-7134-2174; DNA-3067T). NTIS $3.00.

A study was made of methods of adapting constitutive equations for granite to numerical computations of wave propagation. The constitutive equations considered are the so-called capped model, which incorporates a strain-hardening surface to control dilatency and a stationary fracture surface. Difficulties have been encountered in some instances when this model has been used for ground shock computations because the model was unproperly coded. Two acceptable methods of coding the model are described and the results of some test cases are presented which will help reveal errors in the future where similar complicated constitutive equations are being coded for the first time. (auth)

18567 (AD-766543) PROGRESS REPORT, NORSAR PHASE 3. Quarterly Report No. 1, 1 January-31 March 1973. Husebye, E. S. (Norges Teknisk Naturvitenskapelige Forskningsraad, Kjeller. NORSAR). 15 May 1973. Contract F19628-70-C-0283. 22p. (NORSAR-59; ESD-TR-73-213). NTIS $3.00.

The improvement, estimating, and simulating the array detection capability are discussed. The task of connecting NORSAR (Norwegian Seismic Array) to the ARPANET is in progress. The event reporting capability was significantly better in this reporting period than in the corresponding period in 1972. The potential of using amplitude weights in the array beamforming has been investigated and a gain in SNR amounting to 4-6 dB for 8 randomly selected very weak events in Central Asia was achieved. Event magnitudes as reported by NORSAR are similar to those of NOAA (National Oceanic and Atmospheric Administration) for small events (m sub b approximately 4.0) but below NOAA for relatively large events. (auth)

18568 (AD-769848) PROGRESS REPORT, NORSAR PHASE 3. Quarterly Report No. 2, 1 April-30 June 1973. Husebye, E. S. (Norges Teknisk Naturvitenskapelige Forskningsraad, Kjeller. NORSAR). 15 Jul 1973. Contract F19628-70-C-0283. 19p. (NORSAR-61; ESD-TR-73-286). NITS $2.75.

The improvement, estimating, and simulating the array detection capability are discussed. The operational performance of the field equipment has been satisfactory also in this reporting period, and preventive maintenance has been emphasized. Much programming effort has been invested in automating the array monitoring analysis. The 978 seismic events reported in June are mainly due to two earthquake swarms from Japan and Kamchatka. Evaluation studies of NORSAR detection performance gave the best results for events in Central Asia and adjacent regions when the 90% cumulative detectability values are in the range 3.6-3.8 NORSAR m_b units. (auth)

18569 (AD-769849) ARRAY MONITORING AND FIELD MAINTENANCE REPORT. Period Covered: January 1-June 30, 1973. Steinert, O.; Nilsen, A. (Norges Teknisk Naturvitenskapelige Forskningsraad, Kjeller. NORSAR). 6 Aug 1973. Contract F19628-70-C-0283. 52p. (NORSAR-60; ESD-TR-73-287). NTIS $3.50.

The tasks of remote monitoring and field maintenance of NORSAR are described. The corrective maintenance of NORSAR during the first half of 1973 has been of limited extent. A preventive maintenance program for the SP seismograph amplifiers and the WHVs, and a couple of investigations to reduce the maintenance load of certain channel units, were initiated in the period. In general, the different parts of the array field instrumentation have been stable and operated satisfactorily. (auth)

18570 (CEA-R-4496) SECOND FRANCO-AMERICAN EXCHANGE OF TECHNICAL INFORMATION ON THE PEACEFUL USES OF NUCLEAR EXPLOSIONS. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92-Montrouge (France)). May 1974. 151p. (In French). (CONF-721126-).

A second colloquium on the peaceful uses of nuclear explosions was organized the 20 to 24th of November 1972 at the Paris CEA headquarters. The general outline of the colloquium had already been established at a previous meeting at Berkeley during October 1971: the experiments carried out and the predictions made in

conjunction with an exchange program involving Hoggar granite samples and Wagon Wheel sandstone samples are presented and compared. The subjects exposed by the French delegation are grouped, these studies being orientated towards the Wagon Wheel project. The report is divided into seven parts: introduction, soil mechanics, geochemistry, phenomenology of the zone in the vicinity of underground explosions, study of seismic effects, radiological safety, stimulation and quantitative estimates. The corresponding research was conducted by the "Direction des Applications Militaires" of the CEA in collaboration with the Laboratoire de Mécanique des Solides de l'Ecole Polytechnique and l'Institut Francais du Pétrole. (auth)

18571 (COO-2138-12) EARTH STRAIN MEASUREMENTS AND STRAIN RELEASE IN NEVADA AND ADJACENT AREAS. George, G.; Tatar, P.; Taylor, R. W.; Bufe, C. G.; Willis, D. E. (Wisconsin Univ., Milwaukee (USA). Dept. of Geological Sciences). 31 Mar 1974. Contract AT(11-1)-2138. 89p. (CONF-740339-1). Dep. NTIS $7.50.

From 69th annual meeting on Seismological Society of America; Las Vegas, Nevada, USA (29 Mar 1974).

Secular strain plots for Scotty's Junction, Twin Springs and Sleeping Mountain strainmeter stations were constructed for the time period June 1970–June 1971. Annual cyclic strain variations of magnitude 10^{-8} were detected which are correlative with seasonal temperature in this one year period. The phase lags of these strain cycles behind surface temperature are from 30 to 95° (1 to 3 months). Strain ellipses of these stations for the time period June 1970 to June 1971 showed axes of maximum extension trending northwest and axes of maximum compression trending northeast. Digitized strain records from Scotty's Junction showed diurnal variations in strain. Cross-correlation of these records with meteorological and theoretical earth tide data indicates strainmeter sensitivity to both earth tides and temperature. Accumulative strain energy release data were computed for the Nevada, southern and central California areas for the time period 1910 to 1972. The contribution of the testing program at the Nevada Test Site is discussed. Three facets of seismology in the general Nevada-California area are discussed: magnitude relationships between earthquakes and underground nuclear shots; strain energy release for the period 1900 through 1971; and earth strainmeter measurements during 1970 to 1971. (auth)

18572 (DUN-3625) EARTHQUAKE STUDIES OF THE HANFORD AREA. Fifer, N. F. (Douglas United Nuclear, Inc., Richland, Wash. (USA)). 1 Feb 1968. Contract AT(45-1)-1857. 69p. Dep. NTIS $6.50.

The ultimate goal of these earthquake studies has been to establish a reasonable seismic design basis for the Hanford nuclear facilities. While estimates of the maximum earthquake which might be expected in this locality have ranged from a low of about 5% g to a high of 33% g, the evidence in support of a 17% g design value is convincing. Major studies have been performed by Neumann, Brown, Jones, Jahns, and Housner, all of whom have contributed substantially to the overall knowledge of this area. Dr. Housner's recommendation of utilizing a design earthquake acceleration of 17% g at zero period for nuclear process facilities at Hanford has been submitted to Douglas United Nuclear, Incorporated, and design criteria reflecting these recommendations are being prepared. A continuing program of work is in effect consisting primarily of data collection by seismic detection equipment at various locations on the Hanford reservation and additional geologic mapping near the site. This will provide valuable data on coupling of the basalt with the overlying alluvium and the response of the more critical structures. The data will be used in evaluation of the structures and detail design of any required improvements. (auth)

18573 (FOA-4-C-4585-A1) NUCLEAR EXPLOSION IN INDIA, MAY 18, 1974. Hagfors Event Report No. 11. (Foersvarets Forskningsanstalt, Stockholm (Sweden). Hagfors Observatorium). Jun 1974. 26p. Dep. NTIS (US Sales Only) $4.50.

The recorded short- and long-period signals and their spectra obtained at the Hagfors observatory in Sweden from the Indian underground nuclear explosion May 18, 1974 are presented. (auth)

18574 (JAB-99-112) STRUCTURAL EFFECTS PREDICTION GUIDELINES FOR PLOWSHARE PROJECTS. Blume, J. A.; Scholl, R. E.; Reed, J. W.; Skjei, R. E. (Blume (John A.) and Associates, Engineers, San Francisco, Calif. (USA)). Jun 1974. Contract AT(26-1)-99. 174p. Dep. NTIS $7.60.

As part of the planning for the detonation of an underground nuclear explosive for peaceful applications (Plowshare projects), it is essential to predict the effects of the expected ground motion on exposed structures. Because of the many types of structures and the wide variation in ground motion intensity typically encountered in Plowshare projects, no single prediction method is both adequate and feasible for a complete structure effects evaluation. In addition, because of present inherent limitations in the prediction of ground motion and structure damage, effects predictions are most prudently made probabilistically. Initially, prediction for a Plowshare project involves a preliminary assessment of damage to establish overall project feasibility. Subsequent efforts require more detailed damage evaluations based on structure inventories, and, often, detailed analyses of specific structures to identify safety problems and to make recommendations regarding safety and remedial measures. To cover this broad range of effects prediction needs for a typical Plowshare project, three distinct but interrelated methods have been identified and are described. The fundamental practical and theoretical aspects of predicting the effects of dynamic ground motion on structures are presented. Then, based on these fundamentals, the formulation of the three prediction procedures is described and guidelines regarding their applicability are presented. An example low-rise building damage prediction for a hypothetical Plowshare project is made to demonstrate two of the procedures. Finally, operational guidelines pertaining to data acquisition procedures, safety criteria, and remedial measures are provided. (auth)

18575 (NVO-86(Rev.4)) REPORTS AVAILABLE IN PLOWSHARE OPEN FILE. (USAEC Nevada Operations Office, Las Vegas). Jun 1974. 46p. Dep. NTIS $5.50.

Publications available from the open files at the Nevada Operations Office concerning the Gasbuggy, Rulison, Rio Blanco and Wagon Wheel Events within the Plowshare Program are listed. Other publications containing information on the AEC's safety programs for underground nuclear explosions are also listed. The listing includes 86 Gasbuggy reports, 65 Rulison reports, 56 Rio Blanco items, 34 Wagon Wheel reports, and 19 reports on safety programs. (LCL)

18576 (NVO-145) PROJECT RIO BLANCO DEFINITION PLAN, ALTERNATE REENTRY AND TESTING. (USAEC, Washington, D.C.; Continental Oil Co., Ponca City, Okla. (USA)). May 1974. 94p. (PNE-RB-57). Dep. NTIS $7.75.

The Rio Blanco event was an underground nuclear explosion detonated on May 17, 1973 as part of a program for evaluating the feasibility of nuclear stimulation of natural gas production. Initial reentry drill hole data indicated that the chimney from the three explosives used in the experiment and simultaneously detonated at three different depths, did not connect and that the gas flow from the top chimney was much lower than expected. In order to completely evaluate the stimulation effects, more data are needed, and a second, or alternate, reentry hole is planned. The drilling, production testing, formation sampling, safety, security, environmental aspects and project management aspects, including scheduling and cost estimates, of this second reentry operation are presented. (LCL)

18577 (PNE-WW-33) SEISMIC INVESTIGATIONS IN WYOMING AS PART OF THE WAGON WHEEL DEFINITION STUDIES. Bayer, K. C.; Wuollet, G. M. (Geological Survey, Las Vegas, Nev. (USA)). 1974. 30p. Dep. NTIS $4.50.

For El Paso Natural Gas Co., TX.

As part of the Wagon Wheel definition studies, seismic investigations were conducted in Wyoming by personnel of the United States Geological Survey, Las Vegas, Nevada. From March 22, 1973 to February 22, 1974, a seismograph station recorded seismic activity at five different areas in the vicinity of the proposed Project Wagon Wheel location in the Green River basin of Wyoming. The short period vertical component station, located near and around ground zero (GZ) operated for approximately two months at each of five locations at distances from 3 to 21 km from GZ. One hundred and twenty nine (129) natural and man-made events identifiable as located within a radius of 100 km from the station were recorded during the eleven-month study. Calculated magnitudes ranged from $M_L - 0.6$ to M_L 2.6. (auth)

18578 (PNE-WW-37) GROUNDWATER AND PROJECT WAGON WHEEL. Shaughnessy, J. (El Paso Natural Gas Co., Tex. (USA)). May 1973. 22p. (CONF-730595-1). Dep. NTIS $4.25.

From 3rd annual groundwater conference; Bozeman, Montana, USA (25 May 1973).

Wagon Wheel is a project planned to stimulate a well in natural gas reservoirs by means of nuclear explosives and to evaluate the commercial feasibility of such nuclear stimulation. The hydrological testing program undertaken to determine ground water conditions at the Wagon Wheel site in Wyoming is described and the information obtained on ground water flow and locations and site geology and stratigraphy is presented. (LCL)

18579 (UCID-16501) HIGH PRESSURE MECHANICAL PROPERTIES OF INDIANA LIMESTONE. Heard, H. C.; Abey, A. E.; Bonner, B. P. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 11 Jun 1974. 18p. Dep. NTIS $4.00.

The pressure-volume relationship, shear strength at failure, and ultrasonic velocities were measured on dry, 50%-, and 100%-saturated Indiana limestone. Quasi-hydrostatic loadings to 3.9 GPascal show volume changes of 23% and 15% for the dry and 100% saturated limestone, respectively. Several phase transitions were noted. Hydrostatic loading to 1.4 GPascal produces peak compressions of 16%, 11%, and 7%, in the dry, 50%-, and 100%-saturated materials respectively. After unloading to atmospheric pressure, these materials show permanent volume changes of 10%, 7%, and 3%. Bulk moduli are shown to be complicated functions of pressure and water content. Failure envelopes for all three saturations have been determined in compression to 700 MPascal. At pressures <25 MPascal brittle fracture is universal; plastic flow dominates at all higher pressures. The failure envelope for the dry limestone, although increasing with pressure, possesses a monotonically decreasing slope. Shear stresses range from 10 to 260 MPascal. The 50%-saturated limestone shows identical behavior up to 30 MPascal confining pressure; at higher pressures, the shear stress increases only slightly. Complete saturation lowers the shear strength of the limestone to the 40- to 80-MPascal region over the pressure range investigated. Shear and compressional velocities (1 MHz) were measured at atmospheric pressure over the entire saturation range. In the region from 9% to 100% saturation, V_p increased by 6% while V_s decreased 4%. (auth)

18580 (UCRL-51418) KRA PROJECT: A PRELIMINARY ASSESSMENT OF NUCLEAR EXCAVATION FEASIBILITY FOR ROUTE 5A. Toman, J.; Tewes, H.; Peterson, K.; Emerson, D.; Montan, D.; Gibson, T.; Woodruff, W.; Button, J.; Robison, W.; Ng, Y.; Nordyke, M.; Holzer, F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1974. Contract W-7405-Eng-48. 18p. Dep. NTIS $4.00.

A preliminary survey of the possibility of excavating a portion of a canal across the Isthmus of Kra with nuclear explosives has been completed. For the proposed route (designated 5A), a conservative approach has been used to determine "upper limit" values for potential adverse effects resulting from the nuclear and conventional construction phases of the project. Within the limitations of the study, it has been concluded that there are no technical, safety, or operational factors which would preclude the successful implementation of this project. (auth)

18581 (WT-303) DAMAGING AIR SHOCKS AT LARGE DISTANCES FROM EXPLOSIONS. Cox, E. F.; Plagge, H. J.; Reed, J. W. (Sandia Labs., Albuquerque, N. Mex. (USA)). 24 Apr 1952. 108p. Dep. NTIS $8.50.

For determining striking locations of slightly damaging shock pressures from atomic weapon tests, ordinary acoustical laws of refraction and reflection may be employed when distances of interest exceed a few miles. Paths of blast energy propagation are computable from meteorological forecasts or soundings but are limited in accuracy and in altitude by present-day meteorological instruments. Since fundamental wave-lengths of the blast waves 35 to 135 miles from atomic weapon bursts are about 4 kilofeet, energy propagation is affected only trivially by commonplace terrain features, even small ranges of mountains. Mathematical expressions from which blast-energy striking distances and distributions may be calculated from meteorological predictions are presented for eight simplified situations. A new tabular system for computing sound-ray paths from meteorological observations is derived. These derivations are applied to all Operation Buster and Jangle shots, as well as some TNT shots, to demonstrate benefits and weaknesses of the methods. In general, excellent results are achieved in predicting where the blast will strike, but only moderate success has come from our attempts to predict how strong the shock will be on a specific locality and how severe the damage will be. Part of the difficulty stems from the fact that damaging shocks may travel through the ozonosphere, far above heights attainable by present-day meteorological sounding equipment, in their route from source to receiver. Only by comparing measured pressures from a TNT shot fired near intended ground zero shortly prior to an intended atomic weapon shot, with statistical values already obtained and presented in this report, is it possible to estimate locations where ozonosphere-borne shocks may cause damage. Although there is no evidence that they have ever produced damage, shock signals which traveled part of their paths through the ionosphere E-layer are discussed and demonstrated. Further, an explanation is given for the multiple "booms" heard at the control point on the occasions of the Buster Charlie and Easy Shots. (auth)

18582 METHOD FOR INTERCONNECTING NUCLEAR CHIMNEYS. Boardman, C. R. (to United States Atomic Energy Commission). US Patent 3,814,185. 4 Jun 1974. Filed date 27 Feb 1973. 6p.

A method of preparing a subterranean formation for the detonation of a plurality of nuclear explosives is described. Vertical intervals between adjacent, vertically spaced apart nuclear explosive shot points are prefractured by nonnuclear means prior to detonation of the nuclear explosives to assure interconnection of fractures between the two resulting chimneys. (Official Gazette)

18583 ELECTRIC MOMENT OF A NUCLEAR DEBRIS CLOUD. Hill, R. D. J. Geophys. Res.; 79: No. 12, 1750-1754(20 Apr 1974).

Measurements by Holzer (1972) of electric dipole moments of nuclear debris clouds produced by nuclear detonations in the atmosphere have recently been reported. These results are compared with values derived from a Compton current model by using a finite spherical debris cloud. Fair agreement with relative moment changes is obtained, but difficulties are still encountered in obtaining better than a few orders of magnitude agreement with the observed absolute values. Modifications and alternative models are considered. (auth)

18584 GENERATION OF RAYLEIGH WAVES BY UNDERGROUND NUCLEAR EXPLOSIONS: AN EXAMINATION OF THE EFFECT OF SPALL IMPACT AND SITE CONFIGURATION. Viecelli, J. A. Davis, CA; University of California (1973). 75p. University Microfilms Order No. 74-16,298.

Thesis (Ph. D.).

The mechanism of Rayleigh-wave generation by underground nuclear explosions has been examined by experimental and computational methods. The subject is of interest because the principal teleseismic method of discriminating between nuclear tests and earthquakes is based on a comparison of Rayleigh-wave amplitudes. Underground nuclear explosions, even though thoroughly contained, invariably produce spallation. This mass of earth and rock is kicked up by the initial shock wave and falls back within a second or two. The hypothesis that the impact of this material is a source of the surface waves observed from explosions was investigated. The hypothesis was tested by estimating the spall impulse from accelerometer data, computing the surface wave amplitudes consistent with the impulse, and then comparing the results with observed amplitudes. It was also checked by performing computer explosion-simulation experiments, with and without spallation, and comparing the amplitudes of the resulting surface waves. The comparison of amplitudes derived from spall momentum with the observed Rayleigh amplitudes at ranges of 50 to 500 km showed that the spall has sufficient impulse to account for these waves. The computer simulation experiments also showed that the Rayleigh amplitudes corresponding to realistic inelastic spallation have several times the amplitude of Rayleigh waves computed from purely elastic behavior. The surface wave for the spallation case is also delayed relative to the wave from the elastic source. Computer models were also used to estimate the Rayleigh-wave generating efficiency of different configurations of dilatational sources beneath different topographies. Concentrated sources and vertically and horizontally distributed sources placed beneath mountains, canyons, and plains were considered. Signals from a fixed energy release were compared in the time domain. The strongest signal had four times the amplitude of the weakest. The strongest signal was produced by a horizontally distributed source placed beneath a mountain, and the weakest signal was produced by a concentrated source placed beneath a flat plain. The horizontal dimension of the source had the biggest effect on the Rayleigh amplitude. The use of Lagrangian finite difference methods in the numerical studies required an analysis of the effect of the linear Q on the decay of a spherical shock wave in a solid and on the decay of a propagating surface wave. This analysis was accomplished by solution of the partial differential equations approximated by the difference equations. The computer solutions approach an asymptotic form determined by the linear Q, with a decay rate determined by the linear Q. It was determined that to obtain accurate consistent numerical answers it would be necessary to replace the "artificial viscosity" coefficients by input physical coefficients. This was done. Finally, detailed numerical calculations of the Boxcar and Gasbuggy nuclear explosions were performed. These calculations covered the region between the detonation point and the surface, and extended out to a radial distance of slightly greater than 1 km. The constitutive relations describing the material properties were based on laboratory measurements of the mechanical properties of the rocks obtained from the drill holes at the respective sites. The calculations followed the expansion of the vaporized rock at the detonation point, the propagation of the shock to the surface, and the subsequent reflection and spall. Spall impulse and surface displacement profiles obtained from the numerical solutions were in reasonable agreement with values inferred from accelerometers at the respective test sites. (Diss. Abstr. Int., B)

18585 EFFECT OF CONSTITUTIVE PROPERTIES OF EARTH MEDIA ON OUTRUNNING GROUND SHOCK FROM LARGE EXPLOSIONS. Hadala, P. F. Urbana, IL; University of Illinois (1973). 472p. University Microfilms Order No. 74-12,030.

Thesis (Ph. D.).

Ground shock data from the 100- to 10-psi overpressure decade in six large surface high explosive (HE) tests, three from a rock site and three from a glaciated soil site, were analyzed for the effect of gross changes in constitutive properties. Axisymmetric wave propagation code calculations in layered linear and nonlinear (incrementally elastic-plastic) media were performed to determine the effects of (1) introducing nonlinearity, (2) selected material property variations, and (3) the relative importance of airblast and direct induced effects from surface explosions in the overpressure decade of interest. The observed wave forms consisted of a relatively low frequency ground roll with a higher frequency, local airblast related perturbation superimposed. At the soil site, the airblast effects predominated. At the rock site they were much smaller than the ground roll and the duration of the ground roll and its predominant periods were almost an order of magnitude shorter than at the soil site. At both sites, the importance of ground roll increased with decreasing overpressure. Many of the shock spectra calculated contained a low frequency peak and an airblast related high frequency peak with an intermediate valley. Amplification factors determined fell between those used in superseismic airblast and earthquake ground shock analyses. The displacement bound amplification factors for the soil site were 50 percent larger than those for the rock site. No effect of site could be seen in the other two bounds. The ground roll phase velocities were shown to be related to the shear wave velocity profile at each site and data trends consistent with those for surface waves emanating from the vicinity of Ground Zero (GZ) were demonstrated. Peak vertical airblast induced accelerations and particle velocities in the outrunning region were shown to be predictable by relations based on one-dimensional wave theory and previously used in the superseismic region. Ground roll particle velocity amplitudes and periods for different sites correlated well only in nondimensional relations based upon the assumptions that they were due to direct induced effects and that the dominant material property was the seismic shear wave velocity profile. The code calculations confirmed trends previously mentioned on the role of the shear wave velocity profile and the nature of the ground roll in surface detonations. They demonstrated that, at overpressures of 50 psi and below, shock spectra and peak amplitudes of motion from linear calculations were more conservative than were those from nonlinear ones with identical seismic velocities. The wave forms from the nonlinear calculations had the more realistic appearances. The addition of hypothetical energy sources near GZ caused the calculated ground roll to increase severely over that from airblast alone supporting the contention that the source of the surface burst ground roll was in the vicinity of GZ. It was shown that calculated ground roll was strongly influenced by changes in the constitutive properties of deep (¼ to ½ the range of interest) layers which caused changes in reflection phenomena. Code calculated wave forms were in fair agreement with early time motions from 500-ton HE surface bursts at the soil site but were in error at late time due probably to inadequate treatment of direct induced effects. An above ground nuclear detonation at the Nevada Test Site, TUMBLER 1, was also calculated and code generated wave forms were found to be in good agreement with test data, even at late times. This is believed to be the first encouraging calculation of outrunning ground motion from an above ground nuclear burst. (Diss. Abstr. Int., B)

Protective Structures and Equipment

18586 (BNWL-B-319) DUCT GAS COOLING MODEL. Lessor, D. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Feb 1974. Contract A(45-1)-1830. 33p. Dep. NTIS $4.75.

Fires in gloveboxes and other enclosures containing radioactive or toxic materials can produce gas temperatures and burning debris capable of damaging filters in the exhaust ducts. A proposed fire safety plan envisions removing the burning debris by a primary filter near the enclosure and the removal of toxic particles by a filter located downstream in the exhaust duct. In order to evaluate this proposal a computer program was developed for calculating the temperatures produced in the duct as a function of inlet conditions and the gas flow parameters. The results calculated from the mathematical model showed reasonable agreement with experimental results for electrically heated air in 8-in. dia. and 4-in.-dia. ducts. These results can be used in the design of hot cell and glovebox ducts. (LCL)

18587 RASCHET KONSTRUKTSII UBEZHISHCH. (Calculation of the Construction of Shelters). Bodanskii, M. D.; Gorshkov, L. M.; Morozov, V. I. Moscow; Stroiizdat (1974). 207p.

The calculation of the load-carrying construction of shelters from the effects of the shock wave from nuclear explosions, explosions of gas-air mixtures, and from heating during fires was discussed. Methods for the dynamic calculation of curved iron-concrete construction in elastic and plastic stages under different conditions of support were examined. These included off-center compressed elements such as stone walls with consideration of the opening of horizontal cracks, internal columns and walls with consideration of their common performance with the ceiling and floor foundations. (tr-auth)

18588 RADIATION ABSORBING SHIELD FOR PERSONNEL AND MATERIALS AND METHOD OF MAKING SAME. Atkins, B. L.; Bashaw, R. N. (to Dow Chemical Co.). US Patent 3,818,234. 18 Jun 1974. Filed Date 16 Oct 1972. 12p.

A radiation absorbing shield is constructed by providing within confining walls a continuous or particulate gelled aqueous solution containing suitable soluble and/or insoluble radiation absorbing metal salts, or metal particles, said insoluble salts or metal particles being uniformly dispersed throughout the gelled solution. Monomers, e.g., acrylamide, can be polymerized in the aqueous solution containing the radiation absorbing material, in situ, or they can be polymerized, dried and pulverized and mixed with the aqueous solution to form a particulate mass of gel utilizable as a shield against radiation. (Official Gazette)

Vacuum Engineering

18589 (KHFTI-72-9, pp 101-108) ADSORPTION PUMPS. Donde, A. L. 1971. (In Russian).

The operating characteristics of pumps with external placement of adsorbents on cold surfaces and its shields by louvered screens are reported. The construction of the experimental model of the pump is described. Birch coal with a layer thickness of 10 mm was used as adsorbent. Experimental data on the operation of the pump cooled with liquid nitrogen, hydrogen, or helium are given. The range of applicability of such pumps is examined. (tr-auth)

ENVIRONMENTAL AND EARTH SCIENCES

18590 (ORNL-TM-4545) ENVIRONMENTAL SCIENCES DIVISION PUBLICATIONS 1–500: AN ABSTRACTED, INDEXED BIBLIOGRAPHY. (Oak Ridge National Lab., Tenn. (USA)). Mar 1974. Contract W-7405-eng-26. 177p. Dep. NTIS $12.00.

The first 500 Environmental Sciences Division publications are referenced and abstracted in this volume. Indexes are provided by author, keywords, and publication description. (auth)

Minerals and Ores

Refer also to abstracts 18178 and 18909.

18591 (AEC-tr-7567) HYDROTHERMAL CHANGES AND TECTONIC CONTROLS IN THE INTRAGRANITIC URANIUM VEIN DEPOSITS IN THE FRENCH CENTRAL MASSIF. Moreau, M.; Ranchin, G. [nd]. Translation of pp 77-100 of the French Colloque Scientifique International, Paris, 1973. 46p. Dep. NTIS $5.50.

The age measurements made both in Vendee and Limousin indicate that there was an interval of several tens of millions of years between the placement of the granite and the deposit of the uranium-bearing vein [lode] mineral. In spite of the high geochemical uranium background of the granites with two mica strata encasing them, the location of the uranium-bearing deposits cannot be attributed to magmatic differentiation, in contrast to the stannite-tungsten-bearing mineral deposit. The uranium-bearing mineral deposit is located here in lodes or in columns of feldspathic rocks which are more or less micaceous and vacuolar, without any granitic quartz, referred to as episyenites. These rocks are genetically tied to the granite with the two mica layers and their formation is due to postmagmatic phenomena with a hydrothermal character, developed in certain particular zones of the massif; these underwent a rather belated and prolonged evolution. The primary deposit of pitchblende could be due to the abrupt separation of the CO_2 [mixture] whose content is high in terms of certain quartzes in the vicinity of the episyenites and in the mineralized lodes. It is probable furthermore that it is this progressive accumulation of the CO_2 in the fluids prior to the separation of the mixture which is responsible for the final petrographic evolution of the mineralized episyenites. Two superposed Hercynian tectonic phases explain the pitchblende enrichment found at the intersections of the early Stephanian and the late Permian directions. (auth)

18592 (AEC-tr-7568) PRELIMINARY STUDY OF RELATIONS BETWEEN URANIUM AND ORGANIC MATTER IN THE HERAULT DEPOSIT. Chantret, F.; Pouget, R. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). [nd]. Translation of CEA-2069. 16p. Dep. NTIS $4.00.

Coal [carbons] and bitumens are studied through chemical analysis and thermal analysis (thermogravimetry and differential thermal analysis). The correlations between U and organic matter and between U and Mo, Pb are defined. In the case of organic matter bound to rock, it is found that U enrichment is at a maximum when the ratio between carbon and organic matters is close to 0.5. Thermal analysis makes it possible to distinguish various type of bitumens. Besides, the more concentrated the U is in the bitumens, the closer is the ratio between C and H to 28. Certain exceptions point up modification phenomena with the different evolution of the organic matter. The U is in the bitumens probably in the form of an organometallic complex. (auth)

18593 (CONF-700684–) CONFERENCE OF THE NATURAL URANIUM PRODUCERS OF THE COMMUNITY, ISPRA, ITALY, JUNE 18–19, 1970. (Commission of the European Communities, Brussels (Belgium)). 1970. 176p. (In Several Languages).

The basic trends in the development of the Community energy policies are outlined. Perspectives for the development of nuclear energy are considered. The natural uranium supplies presently available to the Community and those of probable availability in the future are discussed. Problems of a technological and economic character in the prospection for and production of U are considered. The results of two programs to calculate the necessary investments for U exploration are discussed and illustrated by two examples. The problems and future prospects in the use of natural U are considered for Sweden, Great Britain, France, Germany, and Italy. (JSR)

18594 (GJO-912-20) STUDY OF THE MORRISON FORMATION IN THE SAN JUAN BASIN, NEW MEXICO AND COLORADO. Sears, R. S.; Marjaniemi, D. K.; Blomquist, J. T. (Pitkin (Lucius) Inc., Grand Junction, Colo. (USA). Geology Div.). Jan 1974. 416p. Dep. NTIS $24.00.

Examination and analysis of the Morrison Formation have been in progress since the 1950's concurrently with uranium exploration and development in this region. The present project combined subsurface and surface investigations including examination of drill cutting samples and logs from petroleum test wells and measurement of surface sections. Stratigraphic units were correlated throughout the basin and laboratory analyses were made of the samples. A total of twenty-nine plates of the region are included in a separate packet. Maps of the most favorable areas for uranium deposits in the Salt Wash, Recapture, and Westwater Canyon Members (Plates XVI, XXI, and XXVI) are in a special pocket following the text. (MCW)

18595 (GJO-912-20(App.Vol.)) STUDY OF THE MORRISON FORMATION IN THE SAN JUAN BASIN, NEW MEXICO AND COLORADO. Sears, R. S.; Marjaniemi, D. K.; Blomquist, J. T. (Pitkin (Lucius) Inc., Grand Junction, Colo. (USA). Geology Div.). Jan 1974. 374p. Dep. NTIS $21.75.

The appendices to the study of the Morrison Formation in the San Juan Basin, New Mexico and Colorado include: Measured Stratigraphic Sections; List of Petroleum Test Wells in the San Juan Basin; Grain-size Distributions for Samples from Measured Sections; Bar and Percentage Graphs of Petrographic Data; Reproducibility of Petrographic Analyses; and Concentrations of Uranium, Thorium, Potassium, and Iron in Samples from Measured Sections. (MCW)

18596 PITCHBLENDE IN URANIUM–MOLYBDENUM DEPOSITS. Dymkov, Yu. M.; Volkov, N. I.; Shilyakova, I. I.; Nazarenko, N. G.; Pavlov, E. G. At. Energ. (USSR); 36: No. 6, 506-512(Jun 1974). (In Russian).

A brief geological and mineralogical description of uranium-molybdenum deposits in metamorphogenic sedimentary rocks is given. Results of chemical analysis of pitchblende and associated carbonates and data on the fine structure of pitchblende and molybdenite spherulites obtained in the course of minerographic and electron-microscopic study of polished sections are presented. It has been possible to reconstruct certain aspects of the genesis of uranium ores based on indications that there occurs pseudomorphosis of uranium minerals replacing coffinite. Alternate formation of pitchblende and coffinite indicates that substitution, dissolution of pitchblende and its subsequent regeneration, occurred under conditions excluding U^{4+} oxidation. (auth)

18597 DETERMINATION OF URANIUM DISTRIBUTIONS IN THE ERTA'ALE (AFAR) VOLCANIC SERIES USING THE FISSION TRACK METHOD. Poupeau, G. (Museum National d'Histoire Naturelle, Paris); Selo, M.; Gaven, C.; Cheminee, J. L. Compt. Rend., Ser. D; 278: No. 4, 405-408(21 Jan 1974). (In French).

The distribution of uranium in lavas of this series was studied together with the different concentrations occurring. Two techniques were used: γ spectrometry for determining overall concentrations (150 samples); fission track method for point localization. (FR)

18598 SELECTED URANIUM MINERAL SPECIMENS. Coogee, Australia; Australian Atomic Energy Commission (1973). 33p.

A brief summary is given of uranium exploration and mining in Australia. A section is included showing twenty-eight color plates of selected uranium and thorium-bearing minerals found in Australia. (AT)

18599 POSSIBLE OCCURRENCE OF THE SUPERHEAVY ELEMENT RADIOACTIVE DECAY PRODUCTS IN NATURE. Gerling, E. K.; Ashkinadze, G. Sh.; Sprintsson, V. D. (Inst. of Geology and Geochronology, Leningrad). Geokhimiya; No. 5, 673-687(May 1974). (In Russian).

The problem of the possible connection of the excess helium content with the decay of superheavy nuclei in three groups of minerals is considered. The formation of helium is possibly connected with α-decay of elements with Z = 110, 114–115 and 120. The excess content in these minerals of ^{40}Ar is explained by the assymetric or three-fold fission of superheavy nuclei. The helium and argon content is highly increased with the age of these minerals which indicates their radiogenic origin. According to these data the half-life period on the hypothetic element has been estimated which proved to be equal to from $300 \cdot 10^8$ to $400 \cdot 10^8$ years. (auth)

18600 LATERAL CHEMICAL VARIATION OF THE GRANITIC AND METAMORPHIC ROCKS ACROSS THE CENTRAL ABUKUMA HIGHLAND WITH EMPHASIS ON THE CONTENTS OF URANIUM, THORIUM, AND POTASSIUM. Ishihara, S.; Hattori, H.; Sakamaki, Y.; Kanaya, H.; Sato, T. (Geological Survey of Japan, Kawasaki). Chishitsu Chosasho Geppo; 24: No. 6, 269-284(Jun 1973). (In Japanese).

The Cretaceous granitic rocks (63 samples) and metamorphic rocks (42 samples) collected across the central Abukuma Highland were examined for their contents of U, Th, K_2O, Na_2O, and other major elements on selected specimens, using γ spectrometry, atomic absorption, colorimetric, fluorescent, and conventional wet-chemical methods. The contents of U and Th of the granitic rocks vary geographically and geologically. They are low in the western belt where the metamorphic grade of the intruded Paleozoic rocks is high; while high in the eastern belt where the metamorphic grade is low. Important bedded-type uranium deposits occurring in the basal part of Miocene formation are located above the granitic rocks of the latter, i.e., above the basement with a high U content and also a high U/K ratio. A regional composition of the granitic rocks in the western belt is more basic than that of the eastern belt. Their Th/U ratio is more variable in the western belt than that in the eastern belt. Contents of U and Th in metamorphic rocks do not depend on grade of the regional metamorphism but largely on "acidity" or "basicity" of the original rocks. The K_2O contents indicate that a regional average composition of Zone C metamorphic rocks seems not to be more acidic than that of Zone B, although Zone C (Takanuki system) has long been believed to contain more pelitic rocks than Zone B (Gozaisho system). Average contents of U, Th, and K_2O of the Abukuma Highland as a whole are definitely lower than those of the Ryoke metamorphic rocks, and are possibly as low as those of the Sambagawa metamorphic terrain. (auth)

18601 ROLE OF SOLID UNDISSOLVED BITUMENS OCCURRENCES OF SHEET-LIKE URANIUM DEPOSITS IN CARBONACEOUS ROCKS. Uspenskii, V. A.; Shmarnovich, E. M.; Umnova, E. G.; Solntseva, L. S.; Pen'kov, V. F. Litol. Polez. Iskop.; No. 4, 83-93(Apr 1973). (In Russian).

The solid insoluble bitumens in one of the sheetlike uranium deposits in the middle of carbonate rocks were studied for the purpose of explaining the role of carbonaceous substances in the location of uranium mineralizations. The following methods were used for the solution of this problem: macroscopic observations, mineralogic studies, luminescence-bitumenological, chemical, and x-ray analyses, and infrared spectroscopy. It was established that in the ore-enclosing carbonate rocks two varieties of solid insoluble carbonaceous substances were included: non-ferrous (or colored) insoluble bitumens and ferrous (or black) solid insoluble bitumens. The non-ferrous solid insoluble bitumens are present in significant quantities in the ore and oreless rocks in all three defined zones of epigenetic change: sheet limonization, uranium mineralizations, and ferrous pyritized rocks. Occurrences of ferrous insoluble bitumens were observed very rarely. The bitumens gravitate as a whole to permeable sections, filling pores, cracks, cavities, oolites, and suturo-stilolite seams. One or another quantity of U can occur as a function of the deposition of bitumens in the sheet-like deposits. The principal mass of the bitumen is ore free. All forms of the solid insoluble bitumens are superposed on enclosing rocks and uranium mineralization. Spatial congruence of the segregation of the solid bitumens with uranium mineralization is explained by the migration of uranium-bearing solutions and hydrocarbon fluids into the carbonate rocks. (tr-auth)

18602 LESS KNOWN RADIOMETRIC ANOMALIES IN WESTERN BOHEMIA. Gnojek, I. (Geofyzika, National Enterprise, Brno). Geol. Pruzkum; 15: No. 4, 105-107(Apr 1973). (In Czech).

The most marked radiometric anomalies of Western Bohemia are described as well as the applied methods of surveying. Measurements of the territory of air anomaly were performed with a portable Czechoslovak-made radiometer. Gamma radiation was detected by an NaI(Tl) scintillator. The rock samples were taken from outcrop or from 70 to 100 cms deep probes. The samples were subjected to laboratory spectrometric gamma analysis, whereby the interpretation was specified of the origin of the individual anomalies. (Nuclear Sci. Abstr. Czech.)

18603 GABON'S NATURAL ATOMIC PILE. Perrin, F. Sci. Tech. (Paris); No. 7, 15-19(15 Oct 1973). (In French).

In 1972, a very localized uranium deposit having a ^{235}U isotope composition as low as 0.44% was discovered in the Oklo mine of Gabon. Under normal circumstances, the ^{235}U composition of uranium ores does not deviate by more than 1 part in a thousand from an average value of 0.72%. The characteristics of the fission of ^{235}U by neutrons are recalled together with the conditions necessary for chain reactions (reactions which take place in nuclear reactors in which a neutron moderator is used in conjunction with natural or enriched uranium) to occur. It is suggested that the depletion observed in the Oklo mine may be due to the occurrence of a chain fission reaction during the formation of rich uranium oxide deposits in spongy siliceous sandstone rocks around 1 billion years ago, when the ^{235}U concentration was about 3%, the reaction being moderated by ordinary water. This hypothesis has been confirmed from chemical and isotopic analysis of rare earth elements present in the deposits having the same compositions as those produced by the fission of ^{235}U. (FR)

18604 GOLDEN AGE OF URANIUM. Hamon, P. Sci. Avenir; No. 12, 30-33(1974). (In French).

The different forms of uraniferous ore present in the earth's crust are reviewed. The various stages involved in transforming uranium ore from its extraction into refined uranium are briefly described. An estimation of the uranium resources and production in the world is given. (FR)

18605 CHANGES IN K, U, AND Th CONCENTRATIONS IN LAVAS OF THE DIFFERENTIATED ERTA' ALE SERIES. Cheminee, J. L. (Univ., Paris). Rev. Geogr. Phys. Geol. Dyn.; 15: No. 4, 353-372(Sep 1973). (In French).

The elements K, U, and Th from 150 samples of the Central Chain of Erta'Ale (Northern Afar, Ethiopia) were analyzed. The lavas of this volcanic series are the result of differentiation by the fractional crystallization of an initial basaltic magma. During the recrystallization of the magma, the elements were concentrated in the residual solution. The Th/U and K/U ratios varied during this differentiation, this variation being explained by the increased mobility of uranium in the magnetic processes. The following values were obtained for these ratios in the upper mantle of Northern Afar: Th/U = 1.6, and K/U = $0.33 \cdot 10^4$ (K = 870 ppM, U = 0.26 ppM, and Th = 0.42 ppM). The calculated heat production in the magma is $A = 0.31 \cdot 10^{-13}$ cal $cm^{-3}s^{-1}$. (FR)

18606 SUPERGENE ORIGIN FOR VEIN-TYPE URANIUM ORES IN THE LIGHT OF THE WESTERN AUSTRALIAN CALCRETE-CARNOTITE DEPOSITS. Langford, F. F. (Univ. of Saskatchewan, Saskatoon, Canada). Econ. Geol.; 69: No. 4, 516-525(1974).

The discovery of a major uranium deposit in the calcretes of Western Australia confirms the economic importance of this type of occurrence. The calcrete is a surficial limestone formed by near-surface groundwater; uranium derived by weathering of nearby granite occurs as carnotite in vugs and fractures in the calcrete. Vanadium has been important in fixing uranium as insoluble carnotite and appears to have been derived from the surrounding laterites. Since the calcretes are unequivocally of surficial and recent origin, the uranium must have been similarily formed. The genetic importance of such surficial processes to the origin of sedimentary deposits of the Colorado type is easily visualized. However, a surficial origin for uranium in pitchblende-vein deposits also satisfactorily explains their spatial and temporal relationships to unconformities and uranium-rich granitic complexes. Vein deposits in the Northern Australia uranium province are good illustrations of the features attributed to surficial sources of uranium in pitchblende-vein deposits. (auth)

18607 URANIUM-LEAD AGES OF THE URANIUM DEPOSITS OF THE GAS HILLS AND SHIRLEY BASIN, WYOMING. Dooley, J. R. Jr.; Harshman, E. N.; Rosholt, J. N. (Geological Survey, Denver). Econ. Geol.; 69: No. 4, 527-531(1974).

The uranium-lead ages for two massive uraninite samples from two deposits, one each in the Gas Hills and Shirley Basin districts, are both 22 ± 3 m.y. as determined by $^{206}Pb/^{238}U$ and $^{207}Pb/^{235}U$. These are sufficiently concordant to confirm an early Miocene time of mineralization for both deposits. Uranium-lead ages for several ore-grade samples from an upper standstone layer of the Shirley Basin indicate 24 ± 5 m.y. The ore samples show less concordancy in age than the massive uraninite samples and are believed to give a less reliable age because of a large common lead correction. Radioactive secular equilibrium between ^{238}U and ^{234}U was determined by alpha spectrometry to be >99% for the massive uraninite samples; equilibrium between ^{238}U and ^{230}Th (ionium) was established by a direct method of isotopic mass ratios. A method of indexing the common lead correction using ^{208}Pb is used with these young samples which contain negligible ^{232}Th. Both the Gas Hills and Shirley Basin uranium deposits, located about 85 miles (137 km) apart, are in the Wind River Formation. The radioactive equilibrium found in the massive uraninite samples supports the reliability of the age found for these two samples. The loss of equilibrium in the ore-grade samples, along with the less reliable lead age, indicates that some local migration of elements occurred surrounding the roll at the Shirley Basin. Apparently this has not affected the lead-uranium system sufficiently to invalidate a date of

22 m.y. for the emplacement of both deposits and the conclusion that ore deposition stopped at about that time. (auth)

18608 THORIUM VEINS IN THE UNITED STATES. Staatz, M. H. (Geological Survey, Denver). Econ. Geol.; 69: No. 4, 494-507(1974).

Thorium-bearing veins present the largest known potential resource of thorium in the United States in deposits that can be easily exploitable in the near future. Veins of this type are principally of quartz, feldspar, and iron oxides and are known from at least 13 widely scattered areas: (1) Lemhi Pass, Montana-Idaho; (2) Diamond Creek, Idaho; (3) Hall Mountain, Idaho; (4) Wet Mountains, Colorado; (5) Powderhorn, Colorado; (6) Laughlin Peak, New Mexico; (7) Capitan Mountains, New Mexico; (8) Gold Hill district, New Mexico; (9) Quartzite district, Arizona; (10) Cottonwood area, Arizona; (11) Monroe Canyon, Utah; (12) Mountain Pass, California; and (13) Wausau, Wisconsin. Veins in these areas range in length from a few feet to at least 5,000 ft and in thickness from thin seams to 50 feet. Many are 200 to 600 ft long and 0.5 to 3.0 ft thick. The veins occupy shear zones and the shearing occurred before, during, and after vein formation. Fracturing in hard, brittle rocks appears unrelated to either the contacts of units or the earlier geologic structures. Fifty-one different minerals have been identified in the veins in the 13 areas. Thorite is by far the most abundant thorium mineral. Monazite is also commonly present and in a few veins there is brockite and allanite. The rare-earth minerals, bastnaesite, xenotime, cenosite, florencite, and synchisite, are all extremely rare except in the veins at Mountain Pass, which contain substantial amounts of bastnaesite. Quartz is the most abundant gangue mineral and is commonly accompanied by microcline. Calcite is common in some areas. Other gangue minerals that are commonly found in moderate to minor amounts in some areas include muscovite, biotite, chlorite, barite, apatite, and fluorite. Iron oxide minerals, especially limonite and hematite, are characteristic of these veins and they commonly stain most of the rock. Over 20 other accessory and secondary minerals of which pyrite and rutile are the most common have been found. The thorium content of samples from various veins ranges from 0.001 to 21.0% ThO_2. The rare-earth content of the veins is substantial and, depending on demand, may be economically as important as the thorium. Although rare earths commonly are present in the same minerals as thorium, there may be little correlation between thorium and rare-earth content in a sample. In eight of the 13 areas thorium veins are associated with alkalic rocks or carbonatites, or both. Carbonatite dikes are generally found near the center of an alkalic rock intrusion whereas thorium veins are at greater distances from the center. The thorium veins are believed to have been derived from a volatile late-stage phase of the magma that formed the alkalic rocks. The low-viscosity fluids traveled long distances in major fractures and slowly formed veins at low temperature, generally in minor shears. (auth)

18609 URANIUM AND POTASSIUM DISTRIBUTION BY LAKE-SEDIMENT GEOCHEMISTRY AND AIRBORNE GAMMA-RAY SPECTROMETRY: A COMPARISON OF RECONNAISSANCE TECHNIQUES. Allan, R. J.; Richardson, K. A. (Geological Survey of Canada, Ottawa). CIM (Can. Mining Met.) Bull.; 67: No. 746, 109-120(Jun 1974).

Two reconnaissance techniques were used to determine uranium and potassium distribution over a 47,000-km area of the northwestern Canadian Shield, and the results from the two surveys are compared. The surveys, using lake-sediment geochemistry with sample sites at 5-km intervals and airborne gamma-ray spectrometry with flight lines 5 km apart, were carried out during the summer of 1972. (auth)

Radioactive Effluents

Refer also to abstracts 18382 and 18397.

18610 (AED-Conf-74-151-016) THE MONITORING OF GASEOUS EFFLUENTS FROM SEVERAL INSTALLATIONS AT THE PETTEN RESEARCH CENTRE. Stoute, J. R. D. 1974. 11p. INIS.

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974).

2 figs.; 8 refs. With abstract.

The current practices of monitoring gaseous and liquid effluents from several installations are considered. Information is given about monitors for nobel gases, aerosols, and radioiodine species as well as about monitoring the liquid wastes released into the North Sea. (GE)

18611 (AED-Conf-74-157-019) REGULATIONS CONCERNING THE MONITORING OF RADIOACTIVE EFFLUENTS AND THEIR APPLICATION IN BELGIUM. Cantillon, G. E.; Stallaert, P. (Institut d'Hygiene et d'Epidemiologie, Brussels (Belgium)). 1974. 9p. (In French). INIS.

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974).

7 refs. With abstract in English and French.

Belgian legislation concerning liquid and gaseous radioactive discharges is described and discussed. Its application with regard to the effluents of the nuclear power plants located in Doel and Tihange is briefly explained. (auth)

18612 (UCRL-75644(Rev.2)) ATMOSPHERIC RELEASE ADVISORY CAPABILITY: RESEARCH AND PROGRESS. Knox, J. B.; Crawford, T. V. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 May 1974. 33p. (CONF-740406-16). Dep. NTIS $4.75.

From 2nd AEC pollution control conference; Albuquerque, New Mexico, USA (16 Apr 1974).

The purpose of the Atmospheric Release Advisory Capability is to provide for real-time predictions of effects and dose-to-man of atmospheric releases of hazardous materials as rapidly and accurately as possible, to provide environmental surveillance and monitoring information in real-time, and to provide regional transport modeling capabilities. Planned technical milestones are shown. (MCG)

18613 RELEASE STATE OF RADIOACTIVE WASTES FROM NUCLEAR POWER PLANTS AND THE COUNTERMEASURES. Kuwashima, K. (Kansai Electric Power Co. Inc., Osaka). pp 287-317 of Siting and Environmental Problems in the Development of Electric Power Stations: Its Status and Analysis. Tomioka, K. (ed.). Tokyo; Fuji International Co. (1973). (In Japanese).

Release of radioactive wastes from nuclear power plants, the presumed exposure dose around the circumference of nuclear power plants, and future countermeasures to reduce the release amount are described. The most important radioisotopes among those generated in nuclear reactors are tritium and krypton-85. The density of tritium in the coolant of pressurized water reactors is by two figures higher than that in boiling water reactors. The exposure dose caused by the release of gaseous radioactive wastes around nuclear reactors is shown. For example, the maximum presumed exposure dose in 1972 around each nuclear power plant of Tsuruga, Fukushima and Mihama was 2.0, 1.4 and 0.02 mrem/year, respectively. In the year 2000, the maximum electric generating power by nuclear energy in the world is presumed to be 4300 gigawatts. Even if all radioactive substances are released and accumulated, the gonad exposure dose by krypton-85 and tritium is evaluated to be 0.1 and 0.001 mrem/year, respectively. Environment Assurance System is one of the countermeasures to the released tritium. As for the countermeasures to reduce the released amount of rare gases including krypton-85, the EAS, rare gas hold-up equipment, pressurized hold-up tanks, low temperature fractionation method, and solvent extraction method are proposed or employed. (JA)

18614 NO ESSENTIAL CHANGES IN THE FIELD OF ENVIRONMENTAL RADIOACTIVITY. Atom-Inform.; No. 2, 4-5 (1974). (In German).

Comments on the Annual Report 1972 of the Federal Secretary of the Interior, "Environmental Radioactivity and Radiation doses", which states that the additional dose to the population from the peaceful uses of atomic energy remains below 1 mrem/a, i.e. below 1% of the natural (background) dose, in spite of the commissioning of further nuclear power plants. (GE)

Radioactivity Monitoring and Transport

Refer also to abstracts 18363, 18736, 18912, 20442, 20452, 20453, and 20455.

18615 (CEA-CONF-2594) TWELVE YEARS OF EXPERIENCE IN MONITORING THE ENVIRONMENT AROUND THE CADARACHE CENTER FOR NUCLEAR STUDIES. Grandin, M.; Roux, R. (CEA Centre d'Etudes Nucleaires de Cadarache, 13-Saint-Paul-les-Durance (France)). 1973. 15p. (In French). (CONF-731117-6; SM-180/48). Dep. NTIS (US Sales Only) $4.00.

From symposium on environmental surveillance around nuclear installation; Warsaw, Poland (5 Nov 1973).

Radiation protection programs at the Cadarache Center for Nuclear Studies, France, from 1961 through 1973 are reviewed. The activities included both environmental and personnel monitoring. (CH)

18616 (EPA-520/5-73-5) ASSESSMENT OF ENVIRONMENTAL RADIOACTIVITY IN THE VICINITY OF SHIPPINGPORT ATOMIC POWER STATION. (Environmental Protection Agency, Washington, D.C. (USA)). Nov 1973. 35p.

Results are reported from a limited assessment of radioactivity levels in the environment in the vicinity of the Shippingport Atomic Power Station, Shippingport, Pa., during 1971 and 1972. Data are reported on the content of ^{131}I and ^{90}Sr in milk samples and ^{90}Sr content of soil samples collected during the period and ambient radiation levels as determined using thermoluminescent dosimeters at various locations. (CH)

18617 (EUR-5138) PROGRAMME BIOLOGY: HEALTH PROTECTION. Annual Report, 1973. (Commission of the European Communities, Brussels (Belgium)). 1973. 794p. (In several languages). Dep. NTIS (US Sales Only) $42.75. EUR B.Fr. 1,000.

The 1971 to 1975 program on biology and health protection was adapted to the situation of 3 new states. The program includes a radiation protection (common program) sector and an applications (supplementary program) sector whose fields of research and objectives include measurement and evaluation of the radiation exposure of man and the various components of the ambient environment to ionizing radiation, such as radiation measurements and their interpretation and the study of the transfer and accumulation of radionuclides in the constituents of the environment and in man. Research summaries and lists of publications are included. (CH)

18618 (KFK-1973) ANNUAL REPORT OF THE RADIATION PROTECTION AND SAFETY DEPARTMENT, 1973. Kiefer, H.; Koelzer, W. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Apr 1974. 174p. (In German). Dep. NTIS (US Sales Only) $11.75.

Radiation protection and technical safety programs in the conventional and nuclear fields at the Karlsruhe Nuclear Research Center are described. Results of routine measurements during 1973 are included. (CH)

18619 (SZS-148, pp 96-106) INSTRUMENTAL AND METHODICAL ASPECTS OF MONITORING FOR RADIONUCLIDES EMITTING LOW-ENERGY RADIATION. Balonov, M. I.; Dolgirev, E. I.; Kaidanovskii, G. N.; Shchamov, V. P. Mar 1973. (In Russian).

From German-Soviet working meeting on the question of radiation protection; Berlin, Germany (8 June 1972).

Detectors and methods for the detection of the radionuclides ^{3}H, ^{14}C, ^{35}S, ^{239}Pu, and ^{241}Am are described. A liquid scintillation counter for aqueous samples, an air monitor for the detection of ^{3}H, and a windowless proportional counter for surface measurements are specially considered. For the detection of ^{239}Pu and ^{241}Am in man a thin NaI(Tl) detector and a large-area proportional counter are applied. Monitoring techniques and results are discussed. (auth)

18620 NUCLEAR PLANTS AND ENVIRONMENTAL PROTECTION. Pellerin, P. (Centre Hospitalier Universitaire, Paris); Moroni, J. P. Ann. Mines; No. 1, 61-70(Jan 1974). (In French).

Many more congresses and articles have been devoted to the behavior of radioisotopes in the environment than to other types of pollution, and no relation exists between the real danger presented and the number of times that the subject has been treated. The public has been led into a state of unjustified anxiety. Since 1928, the International Commission for Radiologic Protection has published recommendations for irradiation levels not to be exceeded, recommendations which are very cautious and based on large numbers of observations. Nuclear plants lead to radioisotope irradiation doses considerably smaller than those due to natural radioactivity or luminous watch dials. (FR)

18621 ENVIRONMENTAL AND RADIOLOGICAL MONITORING AT THE NATIONAL REACTOR TESTING STATION DURING FY-1973 (JULY 1972-JUNE 1973). Markham, O. D. (Atomic Energy Commission, Idaho Falls, ID). Radiat. Data Rep.; 15: No. 5, 227-246(May 1974).

The routine environmental monitoring program at the National Reactor Testing Station (NRTS) during FY-1973 is described. In addition to the measurement of direct radiation exposures in the environment, the concentrations of radioactivity in air, groundwater, and milk also are determined. The results of a soil sampling program are discussed. The data from onsite and nearby community sampling locations are compared to background concentrations and the applicable standards established by the U. S. Atomic Energy Commission. In addition, several special ecological monitoring programs have been designed to assess the effect of NRTS operations on the environment. One of the ecological studies quantifies the level of radioactivity in antelope tissues collected on and near the NRTS. An investigation to ascertain the ratio of ^{129}I to stable ^{127}I in the NRTS environs also is described. (auth)

18622 RE: ERRONEOUS VALUE FOR THE NATURAL ABUNDANCE OF POTASSIUM-40. Bernhardt, D. E. (Office of Radiation Programs, Washington, DC). Health Phys.; 27: No. 1, 159 (Jul 1974).

It is pointed out that several recent reference books, some of which are cited, have propagated an erroneous value for the natural abundance of ^{40}K of (KZM) 0.118% while this value should be about 0.0118%. (UK)

18623 ATMOSPHERIC AND SEAWATER RADIOACTIVITY IN JAPAN. Taiki Hoshano Kansoku Seiseki; No. 55, 1-51(Feb 1973). (In Japanese and English).

Results of the monitoring of atmospheric and seawater radioactivity at 20 stations in Japan in the year 1971 are reported. Gross beta radioactivity in airborne dust was observed. The airborne dust was collected with suction-type collectors with filter system employing paper-filter. For a single observation, air was continuously drawn into the filter system for 5 hours. Seawater was collected aboard ship to measure gross beta radioactivity in the seawater at unscheduled times. The deposition of ^{89}Sr, ^{90}Sr, and ^{137}Cs was observed. The samples were analyzed by radiochemical method. Other results summarized are the natural background radioactivity in atmosphere, the vertical distribution of radioactivity in free atmosphere observed by means of radiosonde carrying a tiny G-M tube, and the microbarographic record at the time of nuclear experimental explosion. (JA)

18624 FOCAL QUESTIONS IN THE NUCLEAR POWER CONTROVERSY. Future Power Production in Norway. Eriksen, V. O. (Institutt for Atomenergi, Kjeller, Norway). Ingenioer-nytt; 10: No. 15, 2-4; 44(19 Apr 1974). (In Norwegian).

Nuclear power problems during routine operations are those of thermal pollution, which is not fundamentally different from other thermal power sources, and contamination from low-level radioactive effluents. While there is disagreement on the interpretation of the ICRP recommendations, there is largely unanimity on their scientific basis. Properly applied there should be no doubt that these recommendations provide for adequate protection of human populations. While catastrophic failures of dams and sea dykes, aircraft crashes on population concentrations, mine disasters etc., are not subject to statistical analysis or predictions, or public debate, this is not the case with nuclear power. Comparative evaluations between the hazards of nuclear power and other comparable hazards should be accentuated. Unfortunate experience with the storage of radioactive waste has colored the debate on radioactive waste disposal. While nuclear safeguards cannot prevent the stealing or misuse of plutonium by, for example, terrorist organizations, it makes it improbable that such can escape detection. (NO)

18625 ENVIRONMENTAL CONTAMINATION BY THE NUCLEAR INDUSTRY. Lopez Perez, B. Energ. Nucl. (Madrid); 19: No. 87, 5-14(1974). (In Spanish).

The development of the nuclear power industry can affect environmental conservation because of the production of radioactive wastes. The terms of the problems are examined and the solutions which appear adequate to resolve the problem with the present level of knowledge are analyzed. The prospects of using new methods of management and processing of radioactive wastes are indicated. (tr-auth)

18626 GENERAL MODEL FOR CALCULATING THE ESCAPE AND TRANSPORT OF ACTIVE PRODUCTS IN NUCLEAR POWER PLANTS AND OF EVALUATING THE CORRESPONDING CONSEQUENCES IN THE NEIGHBORHOOD. Hladky, E.; Kubik, I.; Moravek, J. Bull. EGU; No. 76, 18-24(1971). (In Czech).

On the basis of radioactivity product behavior knowledge a general model was elaborated which describes the main processes effecting radioactivity products release into environment. The general model of radioactivity products transport was used for the formation of a preliminary block schematic diagram for the calculation of radioactivity products concentration in the main protective barriers and for estimation of radioactive products release consequences. In the conclusion the main principles, which will be applied for detailed elaboration of general program for calculation, are summarized. The possibilities of the program application are shown. (auth)

18627 NATURAL RADIOACTIVITY IN THE BIOSPHERE AND FOODSTUFFS. Comar, C. L.; Rust, J. H. pp 88-105 of Toxicants Occurring Naturally in Foods. Washington, DC; National Academy of Sciences (1973).

More than 40 naturally occurring radioisotopes which fall in

the uranium series, the thorium series, and the actinium series have been identified and characterized. Also in existence are non-series naturally occurring radionuclides which have existed since the time of formation of the earth's crust or which are produced continuously by nuclear reactions between components of cosmic radiation and stable isotopes. Of these ^{14}C, ^{3}H, and ^{40}K are of the greatest biological interest. Tabulated data are presented on: the type of radiation and half-life of naturally occurring radionuclides; abundance of ^{226}Ra, ^{232}Th, and ^{40}K in soil and rock types; ^{226}Ra and ^{222}Rn in water supplies; ^{238}U, ^{226}Ra, and ^{222}Rn in natural waters; ^{226}Ra in diets and foodstuffs in U. S. cities; ^{40}K intake and whole-body dose in U. S.; % increase in ^{14}C in northern hemisphere troposphere from 1956 to 1968; natural and man-made tritium production; tritium ratios in atmospheric precipitation in U. S. and Canada; and dose rates from natural sources and from fallout. It is concluded that the external exposure of man in the U. S. ranges from 30 to 115 mrem/y for terrestrial sources and from 30 to 130 mrem/y for sources resulting from cosmic radiation. The natural internal radiation exposure of man is approximately 25 mrem/y, to the whole body. Therefore radiation from the ingested internal emitters is about 25% of the average natural background and about 10% of the average background plus medical and other sources in the U. S. (LCL)

Atmosphere

Refer also to abstracts 18673 and 18685.

18628 (SZS-148, pp 62-67) RESULTS OF MONITORING RADIOACTIVE AEROSOLS IN WORKING AREAS. Maiwald, E. Mar 1973. (In German).

From German-Soviet working meeting on the question of radiation protection; Berlin, Germany (8 June 1972).

Results are discussed that were obtained from measurements performed at VEB Kernkraftwerk Rheinsberg and VEB Uhrenkomtinat Ruhla with regard to concentration and size distribution of aerosols produced during maintenance work and luminous dial painting, respectively. Studies on measurements including the assessment of the activity distribution of aerosols in working areas are described. (auth)

18629 INDUCED AIRBORNE RADIOACTIVITY AT PRAGUE-BULOVKA DURING THE YEAR 1972. Kralik, M. (Lab. for Radiological Dosimetry, Prague). Jad. Energ.; 20: No. 3, 88-90(Mar 1974). (In Czech).

The annual results of measurement of the ground level air induced radioactivity at Prague-Bulovka are given. All values measured in 1972 are compared to those measured in 1971. The month averages of air induced radioactivity at Chilton are added too for comparison. It was proved that short-lived radionuclides in the air could be in connection with the Chinese nuclear test in March 1972. (auth)

18630 WORKING LEVELS OF RADON DAUGHTERS IN AIR DETERMINED FROM MEASUREMENTS OF RaB + RaC. Holmgren, R. M. (Utah Univ., Salt Lake City). Health Phys.; 27: No. 1, 141-145(Jul 1974).

A method of calculating the radon daughter working levels when the daughter equilibrium is undetermined has been developed based on continuous β counting of air sampler filters using the Eberline Air Particulate Monitor Model 700147. A literature search was made to determine the range of daughter concentration ratios to be expected in sampling ambient air. The method for calculation of working levels from total β activity concentrations makes two simplifying assumptions, which are considered. Comparisons are made of working levels determined for various radon concentrations with the working levels estimated by means of the β-counting model. It is concluded that the estimation of working level values in air from determinations of the total RaB + RaC concentration using this model can be quite satisfactory when radon daughters disequilibrium falls within the range of measured ratios reported in the literature. (UK)

18631 SURFACE RADON MEASUREMENT IN THE NORTH PACIFIC OCEAN STATION PAPA. Peng, T. H.; Takahashi, T.; Broecker, W. S. (Columbia Univ., Palisades, NY). J. Geophys. Res.; 79: No. 12, 1772-1780(20 Apr 1974).

Eleven surface radon profiles were measured at windy winter station Papa in the North Pacific Ocean during January and February 1972. A steady state two-layer vertical mixing model is proposed to explain the vertical distribution of radon. The vertical eddy diffusivity within the mixed layer at the Papa site was thus estimated to be about 200 cm^2/s. The mean radon transfer velocity is estimated to be 3.6 m/d. The corresponding magnitude of the thickness of stagnant boundary film is 20 μ. Comparison of this exchange with that obtained previously in the trade wind dominated Bomex area appears to support the results of Kanwisher's (1963) laboratory experiments that show the rate of gas exchange across the air-water interface to be proportional to the square of wind speed. (auth)

18632 ATTEMPT TO OBTAIN AEROSOL SIZE DISTRIBUTION. Kojima, H.; Sekikawa, T. (Science Univ. of Tokyo). J. Meteorol.; 51: No. 5, 287-293(Oct 1973).

A method is proposed for the detection of the size distribution of atmospheric aerosols that have a radius from 5×10^{-7} to 5×10^{-6} cm. To make a charge equilibrium of aerosols in which the fraction of charged particles depends on the size of the aerosols, the sample air containing the aerosols was irradiated with ^{210}Po (α rays, approximately 100 μCi) and the ion mobility distributions were obtained by the ion analyzer. The relation between the size (electrical mobility) and the charged fraction of the aerosols irradiated with ^{210}Po was measured. From the result it was known that the Boltzmann distribution law was not valid for the small size. On the basis of this result, the ion mobility distribution was transferred to the size distribution of the particles. This irradiation method was applied to the measurement of diurnal variation in the size distribution in the urban atmosphere. (auth)

18633 SEPARATE DETERMINATION OF MULTIPLE RADIOACTIVE CONTAMINATIONS IN AIR-BORNE DUST RESULTING FROM NUCLEAR DEBRIS OF DIFFERENT ORIGINS. Yukawa, M.; Kamada, H.; Saiki, M. (National Inst. of Radiological Sciences, Chiba, Japan). Nippon Kagaku Kaishi; 1974: No. 2, 263-268(Feb 1974). (In Japanese).

The change of radioactivity ratio ($^{95}Nb/^{95}Zr$) as far as reaching the equilibrium value 2.18 was utilized for the fractionation of multiple contaminations produced by the fission products from different origins into each origin and its scale. The airborne dust used as the sample was contaminated by the debris from a series of nuclear explosion tests carried out on 18 Nov. 1971, 7 Jan. 1972 and 18 May 1972 in People's Republic of China. The simultaneous equation analysis on the growing of ^{95}Nb from ^{95}Zr, the decay of ^{95}Zr and radioactivity ratios $^{95}Nb/^{95}Zr$ was performed. The results showed that each contribution rate of ^{95}Zr originated from individual nuclear explosion test to the total radioactivity of ^{95}Zr in air borne dust could be calculated with considerable accuracy and the rate of ^{95}Zr from the test on 7th Jan. 1972 was the largest. Therefore, it was estimated that the contamination effect to air borne dust by the fission products of this nuclear explosion test was the largest. The age of the newest fission products among the several nuclear fissions could be estimated successfully, when ratios were determined within about a hundred days after the nuclear fission and were observed twice at suitable intervals. (auth)

18634 GENERAL CALCULATION METHOD FOR NUMERICALLY FORECASTING POLLUTIONS CARRIED BY THE ATMOSPHERE. Doury, A. (CEA, Paris). Meteorologie; No. 19, 1-34(Jul 1971). (In French).

An automatic, convenient, and economically viable method is proposed for numerically solving most problems connected with the forecasting of pollutions carried by the atmosphere. The physical basis of the method is particularly simple and logical. In addition, the model can be continuously improved and adapted to real physical situations by altering the values of a few parameters. A single analytical solution for an instantaneous but not necessarily point source is used to obtain results suitable for any type of source. These results, which have confidence limits consistent with the accuracy of the measurement equipment used, lead to reasonable values for the pollution. The range of meteorological conditions has necessarily been reduced to a minimum, but is probably sufficient for most common applications. All operations (both pollution forecasting and improvements to the model) can be batch processed using a passive memory electronic computer. (FR)

18635 EVALUATION OF THE RADIOACTIVITY OF THE GROUND-LEVEL ATMOSPHERE IN CZECHOSLOVAKIA IN THE PERIOD 1970-1971. Santroch, J. (HMU, Prague). Meteorol. Zpr.; 26: No. 6, 175-184(Dec 1973). (In Czech).

The results of continuous measurements of artificial radioactivity of atmosphere and fallout on the territory of Czechoslovak Socialist Republic for the 1970-1971 period are reported. The radioactivity of monthly, weekly and daily fall-out was measured. The concentrations of radioisotopes ^{144}Ce and ^{137}Cs in air aerosol were evaluated spectrometrically. As in the previous works, the rising tendency of the total beta-radioactivity of air aerosol and fall-out caused by atmospheric tests carried out by the People's Republic of China in the period observed must be stated. In conclusion the brief meteorological analysis of extreme values of air radioactivity is given. (auth)

Soil

Refer also to abstract 18907.

18636 (IDO-22054) DIGITAL MODELING OF RADIOACTIVE AND CHEMICAL WASTE TRANSPORT IN THE SNAKE RIVER PLAIN AQUIFER AT THE NATIONAL REACTOR TESTING STATION, IDAHO. Robertson, J. B. (Geological Survey, Idaho Falls, Idaho (USA). Water Resources Div.). May 1974. 47p. Dep. NTIS $4.00.

Industrial and low-level radioactive liquid wastes at the National Reactor Testing Station (NRTS) in Idaho have been disposed to the Snake River Plain aquifer since 1952. Monitoring studies have indicated that tritium and chloride have dispersed over a 15-square mile (39-km^2) area of the aquifer in low but detectable concentrations and have only migrated as far as 5 miles (8 kilometers) downgradient from discharge points. The movement of cationic waste solutes, particularly ^{90}Sr and ^{137}Cs, has been significantly retarded due to sorption phenomena, principally ion exchange. ^{137}Cs has shown no detectable migration in the aquifer and ^{90}Sr has migrated only about 1.5 miles (2 km) from the Idaho Chemical Processing Plant (ICPP) discharge well, and is detectable over an area of only 1.5 square miles (4 km^2) of the aquifer. Digital modeling techniques have been applied successfully to the analysis of the complex waste-transport system by utilizing numerical solution of the coupled equations of groundwater motion and mass transport. The model includes the effects of convective transport, flow divergence, two-dimensional hydraulic dispersion, radioactive decay, and reversible linear sorption. The hydraulic phase of the model uses the iterative, alternating-direction, implicit finite-difference scheme to solve the groundwater flow equations, while the waste-transport phase uses a modified method of characteristics to solve the solute transport equations simulated by the model. The modeling results indicate that hydraulic dispersion (especially transverse) is a much more significant influence than previously suggested by earlier studies. The model has been used to estimate future waste migration patterns for varied assumed hydrological and waste conditions up through the year 2000. The hydraulic effects of recharge from the Big Lost River have an important (but not predominant) influence on the simulated future migration patterns. For the assumed conditions, the model indicates that detectable concentrations of waste chloride and tritium could move as much as 15 miles (24 kilometers) downgradient from the original discharge points by the year 2000. However, the model shows ^{90}Sr moving only 2 to 3 miles (3 to 5 km) downgradient in the same time. The model may also be used to estimate the effects of the various future waste disposal practices and hydrologic conditions on subsequent migration of waste products. (auth)

18637 TRITIUM MOVEMENT IN SOILS. The Importance of Exchange and High Initial Dispersion. Jordan, C. F.; Stewart, M. L.; Kline, J. R. (Argonne National Lab., IL). Health Phys.; 27: No. 1, 37-43(Jul 1974).

Results of a field experiment to determine tritium movement through soil were compared with several predictions made by a mathematical model. The input parameters of the model were evapotranspiration, soil water diffusion, gravity flow and the past 48 hr history of rain. Initial predictions of the quantity of tritium in soil as a function of time were about an order of magnitude too low. The fit was greatly improved when tritium exchange with hydrogen on soil particles and a high initial dispersion through large soil pores were incorporated into the model. (auth)

18638 MODELIROVANIE PROTSESSOV MIGRATSII RADIOIZOTOPOV V LANDSHAFTAKH. (Simulation of Migration Processes of Radioisotopes in Dry Land Areas). Anokhin, V. L. Moscow; Atomizdat (1974). 144p.

A mathematical simulation of the processes of migration of biogeowaste-contained radioisotopes in different dry land areas was done using the most modern methods of analysis of the existing or proposed situation and the prognosis of its subsequent changes. This simulation was used for planning sanitary measures. Tests were given for the construction of logic schemes of structural and functional categories of these simulations; the matric algorithms of linear algebra were carried out by the mathematical apparatus. Theoretical concepts of the physical-chemical mechanisms of the sorption and transport distribution of radioisotopes between liquid and solid phases during filtration in the soil were given. Questions on the simulation of the biological cycle were also considered. (tr-auth)

Water

Refer also to abstracts 18610, 18661, and 18674.

18639 (RT/PROT-(73)35) PRESENTATION AND DISCUSSION OF THE RESULTS OF THE RADIOACTIVITY MEASUREMENT IN THE SEWAGE OF SOME ITALIAN CITIES. Coangelo, S.; Cortellessa, G. C.; Terrani, S. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 20 Dec 1973. 9p. (In Italian). (CONF-711082-2). Dep. NTIS (US Sales Only) $4.00.

From Italian Association for Health Physics and Protection Against Radiation meeting; Rome, Italy (5 Oct 1971).

Results are reported from measurements of radioactivity in waters and sludges sampled in the sewer trunks of two Italian towns (65,000 inhabitants). The measurements were concerned with the radionuclides (^{131}I, ^{203}Hg, ^{198}Au) used in medical studies. The results are discussed and compared with each other and with those obtained from measurements carried out in the sewer trunks of Milan, having in mind the difference existing between the water and sewage systems of the three towns. (auth)

18640 (SZS-148, pp 130-133) ENVIRONMENTAL MONITORING AND SPECIAL SURVEILLANCE OF THE CONTAMINATION OF FLOWING WATERS WITH LONG-LIVED RADIONUCLIDES. Kunert, J. Mar 1973. (In German).

From German-Soviet working meeting on the question of radiation protection; Berlin, Germany (8 Jun 1972).

At present in the GDR fallout monitoring is performed according to a minimized program. The monitoring results obtained in the GDR and the RSFSR (Research Institute of Radiation Hygiene in Leningrad) in 1971 are compared. Subsequently the main aspects of a working programme for monitoring the contamination of waters with long-lived natural radionuclides are presented. The results of this program shall serve as a base for the establishment of founded contamination limits. (auth)

18641 PRELIMINARY SURVEY OF THE CONDITIONS OF GENESIS OF RADON IN THE GROUND WATER IN PEKING AND ADJACENT REGIONS. Chen, I. C.; Peng, K.; Kao-Chen, H. T. Ti Chih Ko Hsueh; No. 2, 167-174(May 1973).

Based on data available from 46 springs and 55 wells in Peking and adjacent regions, the conditions of the genesis of radon in ground water are described. The importance of the geological and hydro-geological background on the genesis of radon in ground water is emphasized. It is concluded that radon in ground water was derived mainly by means of diffusion of radon emanation from cracks and pores of the surrounding rocks. The data showing the distinct effect of water temperature and air temperature on the concentration of radon in ground water are listed. (JPRS)

18642 PATTERNS OF RADIOCESIUM IN THE SEDIMENTS OF A STREAM CHANNEL CONTAMINATED BY PRODUCTION REACTOR EFFLUENTS. Brisbin, I. L. Jr.; Beyers, R. J.; Dapson, R. W.; Geiger, R. A.; Gentry, J. B.; Gibbons, J. W.; Smith, M. H.; Woods, S. K. (Savannah River Ecology Lab., Aiken, SC). Health Phys.; 27: No. 1, 19-27(Jul 1974).

Levels of radiocesium contamination of the sediments of the stream bed, delta, and associated floodplains of Steel Creek of the AEC Savannah River Plant are among the highest reported for a natural system. Desorption studies have shown that the radiocesium is not tightly held by the sediments. Fine-particle silt and clay sediments averaged 170.47 pCi/g dry weight, with a maximum of 561.96 pCi/g dry weight and were higher in radiocesium content than the coarser sediments which averaged 18.10 pCi/g. Differential distribution of fine and coarse sediments in the stream channel region has resulted in a complex surface mosaic of radiocesium contamination. Samples collected 1 m apart differed in radiocesium content by as much as 190% of their mean. Greater deposition of fine sediments on the delta has given this area the greatest total radiocesium content, although the radiocesium content of the fine sediments, on a per gram basis, was no greater in the delta region than further upstream. Radiocesium was correlated with both available potassium and the organic matter content of the sediments, and over 68% of the total radiocesium was found in the upper 20 cm of sediments. (auth)

18643 INFLUENCE OF SOME HYDROLOGICAL PARAMETERS ON CHANGES IN THE RADIOACTIVITY OF THE WATERS OF THE RIVERS CZARNA PRZEMSZA AND PRZEMSZA. Kwapulinski, J.; Zubik, T. Acta Hydrobiol.; 14: No. 3, 257-271(1972).

Radioactive contamination can originate from fallout, precipitation, and industrial sources. The influence of water level, water temperature, area of the reception basin, dry residue, and water flow on the specific radioactivity of the water was established. On the basis of investigations and the known coefficient of flow changeability and dry residue, the degree of the relationship between these parameters on any part of the river can be established. No correlation between the specific radioactivity of the water and dry residue of flow was found for the coefficient of dry residue variability

(0.30) and for the coefficient of the variability of flow (0.269). The greatest contamination occurred in 1965 and 1969; contamination of the river Czarna Przemsza varied from 9.8 to 70.8 pCi/dm^3. The specific radioactivity of the water in the river Przemsza at its mouth was slightly lower, varying from 8 to 38 pCi/dm^3. (Pollut. Abstr.)

18644 RADIOACTIVITY OF WATERS IN THE VICINITY OF JASLOVSKE BOHUNICE BEFORE STARTUP OF THE NUCLEAR POWER PLANT. Csupka, S. (Regional Hygienic Station, Bratislava). Vod. Hospod., B; 22: No. 7, 183-185(1972). (In Slovak).

Data are presented designed as a basis of evaluating the increase in activity of waters in the vicinity of Jaslovské Bohunice due to startup of the nuclear power plant. The monitoring of radioactivity of waters on the territory of western Slovakia conducted between 1968 and 1970 showed that the average annual values were constant and that annual fluctuations were due to an increased fallout and to meteorological conditions. (Nuclear Sci. Abstr. Czech)

18645 DISPERSAL OF TRITIUM IN SOUTHERN OCEAN WATERS. Tamuly, A. (Univ. of Quebec, Rimouski). Arctic; 27: No. 1, 27-40(Mar 1974).

The depth distribution of tritium in Southern Ocean waters is reported. Decrease of tritium in surface waters from about 2TU at 38°S. to 40°S. latitude, to 1.3 TU and 1.1 TU at 45°S., 55°S. and 64°S. latitudes, are very likely to be associated with the presence of convergence and divergence areas at subtropical and subantarctic latitudes in the Southern Ocean. A tritium-free layer has been found to exist at intermediate depths. Significant increase of tritium in waters at and below 4 km. strongly suggests a younger age, a minimum of the order of 25 years for the bottom waters circulating in the entire region to the south of South Australia. (auth)

18646 TRAPPING OF CERIUM-144 AND YTTRIUM-91 BY OCEAN SEDIMENTS. Spitsyn, V. I.; Bernovskaya, R. N.; Gormov, V. V.; Bogdanov, Yu. A. (Inst. of Physical Chemistry, Moscow). Oceanology (USSR) (Engl. Transl.); 12: No. 4, 586-589(Apr 1973).

Absorption of ^{144}Ce and ^{91}Y by typical forms of bottom sediments of the Indian Ocean was investigated; ^{144}Ce and ^{91}Y are present in a complex physicochemical state in the ocean, and the best absorbents are fine-aleurite radiolarian muds. The mechanism of extraction of ^{144}Ce and ^{91}Y from seawater is a combination of trapping of colloidal particles of these elements by the sediment, and absorption on the latter portion of the radioelement that is present in seawater in a truly dissolved state. (Pollut. Abstr.)

18647 RADIONUCLIDE DECAY IN STEADY STATE RESERVOIRS. Thiebaux, M. L. Jr.; Thiebaux, H. J. (National Oceanic and Atmospheric Administration, Boulder, CO). Water Res.; 8: No. 7, 447-453(Jul 1974).

The natural decay of a radionuclide during detainment in a reservoir by large scale circulation processes is considered under steady state conditions. It is shown that when the residence time distribution is a step function, a one-parameter model is defined with the least possible effluent radioactivity. A second one-parameter model, yielding significantly greater radioactivity, is defined if the reservoir contents are uniformly mixed. Reservoir models of higher complexity may be constructed by a systematic linking together of the one-parameter models. Effluent radioactivities determined by the only possible two-parameter models are less than or equal to that of the uniformly mixed model. This fact is demonstrated by several specific examples. (auth)

Ecosystems and Food Cycles

Refer also to abstract 20543.

18648 (AEC-tr-7536) RADIOACTIVE IODINE IN THE PROBLEM OF RADIATION SAFETY. Il'in, L. A.; Arkhangel'skaya, G. V.; Konstantinov, Yu. O.; Likhtarev, I. A. Jun 1974. Translation of Radioaktivnyi iod v Probleme Radiatsionnoi Bezopasnosti, Atomizdat, Moscow, 1972. 269p. Dep. NTIS $7.60.

The possible effects of ^{131}I release to the environment on various segments of the public and on various professional personnel are reviewed. It is pointed out that the radioactive isotopes of iodine are the leading component of accidental discharges at nuclear reactors which have water and gaseous coolants and in nuclear bomb fallout. Hence, in an emergency situation both the personnel maintaining the facility and the public living in the surrounding region may be exposed to these radionuclides. The extent of the radiation danger from the release of radioiodine to the environment may differ depending on the meteorological conditions of atmospheric dispersion of the discharge, the agricultural use of the contaminated territory, the presence of people in the area, and the use of locally produced milk. Calculations show that for an unfavorable combination of these factors a single discharge of, for instance, 1,000 Ci of ^{131}I (0.04 percent of the equilibrium activity of ^{131}I in a nuclear reactor having a thermal output of 100 Mw) may lead to the fact that the irradiation of a child's thyroid gland will reach 25 rad at distances of up to 13 km as a result of the inspiration of radioiodine and up to 70 km as a result of the consumption of the contaminated milk from local cows. (auth)

18649 (LA-tr-74-11) CONTAMINATION OF TERRESTRIAL GASTEROPDA IN A BIOTOPE WITH LOW-LEVEL α CONTAMINATION DUE TO PLUTONIUM AND URANIUM. Alvarez-Ramis, C.; de Los Santos, A. G. 1974. Translation of pp 961-982 from International Conference on Radioecology, Cadarache, France, September 8-12, 1969, Volume 2. (CONF-690918-5). 20p. Dep. NTIS $4.00.

From conference on radioecology; Cadarache, France (8 Sep 1969).

A study was made of the degree of α contamination of the terrestrial gasteropoda (Leucocroa Candidissima, Helix punctata, and Helix pisana) caused by the rupture of a thermonuclear bomb at Palomares (Almeria, Spain). Data are included on the α radioactivity of the plants on which they live, whether cultivated plants (corn, broad beans, tomatoes, cabbages, etc.), or wild plants typical of the subtropical climate of this zone (Lygeum spartum, Asparagus horidus, Passerina hirsuta, etc.). The degree of α radioactivity of the different soil types was also studied. Radioactivity was measured in the first five centimeters depth of the first layer where the fixed radioactivity acts most easily and directly on the gasteropoda. The relationships existing between soil, plant, and gasteropoda flesh and shell contamination was studied. (auth)

18650 (NRL-F-50) ENVIRONMENTAL RADIOACTIVITY ANNUAL REPORT, 1972. (National Radiation Lab., Christchurch (New Zealand)). Apr 1973. 37p.

Long-term levels of environmental radioactivity in New Zealand and at Fiji and Rarotonga are analyzed and compared with levels in previous years. Levels of ^{90}Sr and ^{137}Cs in milk were ½ of the maximum levels recorded in 1965, and fission levels in air and rainwater were the lowest since 1966. Radionuclides analyzed include ^{90}Sr, ^{89}Sr, ^{137}Cs, and ^{210}Pb. Data on radionuclides in human bones are also presented. (Pollut. Abstr.)

18651 (ORO-3852-15) GEOCHEMICAL BEHAVIOR OF URANIUM AND THORIUM SERIES NUCLIDES. Annual Progress Report, 1973-74. Sackett, W. M. (Texas Agricultural and Mechanical Univ., College Station (USA)). 1974. Contract AT (40-1)-3852. 11p. Dep. NTIS $4.00.

Samples were collected to measure ^{226}Ra and ^{228}Th distributions in the Gulf of Mexico. Summary profiles of the ^{226}Ra/^{228}Ra activity ratio, salinity, temperature, and dissolved oxygen are given for three stations to study mixing dynamics in the Gulf. Studies are also being made of radium and uranium in livestock feed additives. (MCG)

18652 (UCRL-51345(Rev. 1)) NUCLEAR CHEMICAL COPPER MINING AND REFINING: RADIOLOGICAL CONSIDERATIONS. Tewes, H. A.; Levy, H. B.; Schwartz, L. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Jun 1974. Contract W-7405-eng-48. 36p. Dep. NTIS $4.00.

It has been proposed that relatively impermeable copper ore bodies be fractured by means of nuclear blasting, and that this fractured ore be leached with water containing dissolved oxygen under relatively high hydrostatic pressure. A preliminary radiological safety analysis of the proposed nuclear chemical mining and refining process for copper was carried out. Exposure sources and paths, exposed populations, and dose levels are all discussed. Existing data were utilized in the formulation of this safety analysis, and conservative (i.e., worst case) assumptions were used where data were unavailable. Despite the upper limit formulation of hypothetical radiological exposures to members of the public, all such exposures were found to be far below (much less than 1% of) current radiation protection guides. (auth)

18653 PHYSIOLOGICAL AND BIOCHEMICAL ASPECTS OF THE ACCUMULATION OF CONTAMINANT RADIONUCLIDES IN MILK. Lengemann, F. W.; Wentworth, R. A.; Comar, C. L. pp 159-215 of Lactation. Vol. III. Nutrition and Biochemistry of Milk/Maintenance. New York; Academic Press, Inc. (1974).

Milk is a product produced by animals whose food intakes represent large amounts of surface area susceptible to contamination, the handling of milk requires rapid movement to the consumer, and

milk constitutes a very important food item, especially for the very young. As is evident from the presentation, work on radiocontaminants to date has centered on ^{131}I, ^{90}Sr, and ^{137}Cs. These radiocontaminants were considered to be the most potentially harmful of those found in the debris from weapons testing. Perhaps more emphasis should have been given to radiocesium but this conclusion is based only on fairly recent evidence. With the nuclear industry becoming more of a reality the emphasis is shifting from fallout to those radionuclides which are likely to be in the waste gases and effluents of these facilities. The study of radiocontaminants has been directed to answering the questions of whether a material will move through the food chain, to quantitate such movement, and to attempt to build prediction models. As these questions were answered the emphasis shifted to finding means of reducing the radiocontaminants that appeared in milk. Some of these countermeasures studied were centered on the dairy animal and so it became necessary to learn something about the physiology and biochemistry of the transfer of the radionuclides into milk. To this extent the study of radiocontaminants has contributed to the basic knowledge of the mechanisms of milk secretion. These studies in general have not been in depth because the need did not exist. Detailed studies of the transfer of these materials from blood to milk will have to be left to the physiologists. It is evident that those radionuclides of significance as a result of increasing use of nuclear energy will need to be looked at to determine how they move through the food chain and how important milk is as a vehicle for their transport to man. (auth)

18654 TRACER TECHNIQUES IN THE STUDY OF POLLUTION PROBLEMS. Water and Pollution Transfer in Surface Hydrology, Underground Hydrology, and Purification Processes. Application to the Optimization of Waste Disposal Methods and to the Definition of Safety Boundaries. Molinari, J. (CEN, Grenoble, France). Nuisances Environ.; 191-206(Oct 1973). (In French).

From colloquium of the anti-pollution techniques exhibition; Grenoble, France (2 Oct 1973).

The group "Applications of Radioisotopes to Hydrology and Industry" has specialized over the last 10 years in the measurement and interpretation of isotopic indicators and other substances present in the trace state in the hydrologic cycle. Both substances occurring in water as a result of human activities and those deliberately introduced for the purpose of specific determinations were considered. The usefulness of this type of investigation is illustrated with examples of work already carried out by the service. (FR)

18655 MIGRATION OF STABLE AND RADIOACTIVE ISOTOPES OF ALKALINE AND ALKALI-EARTH ELEMENTS IN THE BIOLOGICAL CHAIN SOIL–PLANT–MILK. Aleksakhin, R. M.; Sirotkin, A. N.; Nikolaeva, E. M.; Gol'tsev, V. F.; Naryshkin, M. A. (Lab. of Forest Sciences, Moscow). Zh. Obshch. Biol.; 35: No. 3, 414-422(1974). (In Russian).

Transfer of K, ^{137}Cs, Ca, ^{90}Sr, and stable Sr from the soil to the herbaceous plants, and further, to the milk after a single contamination of the meadow with ^{137}Cs and ^{90}Sr was studied. In the chain soil–grass K proves the most labile, the accumulation of ^{137}Cs in the grass being 400-fold lower. The coefficients of the accumulation of Ca, ^{90}Sr and Sr_{stab} in the grass (the ratio of these nuclides concentrations in the grass and the soil respectively) are circa equal (2 to 2.5). In the chain grass–milk the transfer coefficients (the ratio of these nuclides concentrations in the milk and the grass respectively) are 0.11 for Ca and ^{137}Cs, 0.01—for ^{90}Sr and Sr_{stab}, 0.06—for K. The transfer coefficients for the chain soil–milk are found to be the highest in the series: $K \gg Ca > {}^{137}Cs \cong {}^{90}Sr \cong Sr_{stab}$. Ca, ^{90}Sr, Sr_{stab}, K and ^{137}Cs obtained from 1 litre of milk constitute 1.4, 0.11, 0.10, 0.76, and 1.50% respectively of the daily dose consumed with the diet (grass). The content of ^{90}Sr in the soil being 1 mCu per 1 km^2, 1 pCu $^{90}Sr/g$ Ca (1 strontium unit, s.u.) is accumulated in the diet (grass), and 0.1 pCu $^{90}Sr/g$ Ca (s.u.)—in the milk. The content of ^{137}Cs in the soil being 1 mCu per 1 km^2, the concentrations of ^{137}Cs in the diet (grass) and in the milk are respectively 1.6 and 0.18 pCu per 1 kg. (auth)

18656 ALPHA CONTAMINATION LEVELS OF ALGAE OF THE SPANISH MEDITERRANEAN COAST. Alvarez Ramis, C.; Montesinos del Valle, M. (Junta de Energia Nucleare, Madrid). Energ. Nucl. (Madrid); 19: No. 87, 41-45(1974). (In Spanish).

The importance of algae in the food chain and its capacity to concentrate elements present in the aquatic medium have motivated the determination of the level of its contamination for α emitters in the specific case of the most important Mediterranean species. It is proved that U is the principal contaminating agent. (tr-auth)

18657 PARTICULATE ORGANIC ^{32}P IN A SIMULATED SEDIMENT–WATER SYSTEM. Westerdahl, H. E. Norman, OK; Univ. of Oklahoma (1973). 201p. University Microfilms Order No. 74-12,326.

Thesis (Ph. D.).

The role of the sediment heterotrophic community in the biodegradation of algal particulate organic ^{32}P and the subsequent release of ^{32}P to the overlying water was studied. To accomplish this, a simple laboratory continuous flow sediment and water system was designed to simulate a portion of the sediment-water interface. The data revealed that the rate of mineralization of particulate organic ^{32}P was much slower than previously suggested in the literature. It was also shown that the capacity of the sediment to sorb phosphorus, as well as the redox condition in the overlying water, affected to a lesser extent the interchange of ^{32}P to the overlying water. The rate of degradation of the algal particulate organic ^{32}P was apparently the major rate controlling step in governing the release of ^{32}P to the overlying water. (Diss. Abstr. Int., B)

Radiometric Techniques

Refer also to abstracts 18172, 18606, 18622, 18651, 18654, 18672, 18777, 18778, and 18781.

18658 (COO-3132-17) ORIGINS OF DEEP-SEA SEDIMENTS AND THEIR VARIATIONS WITH TIME. Annual Progress Report No. 5. Biscaye, P. E. (Columbia Univ., Palisades, N. Y. (USA). Lamont-Doherty Geological Observatory). May 1974. Contract AT(11-1)-3132. 28p. Dep. NTIS $4.50.

Mechanisms of sediment dispersal are being studied using radon, isotopic variations, and spectroscopy. Lists of papers published are included. (MCG)

18659 (ORNL-TM-4572) APPLICATIONS OF THERMOLUMINESCENCE MEASUREMENTS IN ANCIENT CERAMICS. Becker, K.; Moreno y Moreno, A. (Oak Ridge National Lab., Tenn. (USA)). Jun 1974. Contract W-7402-eng-26. 35p. Dep. NTIS $4.75.

TL measurements in seven different types of precolumbian potsherds from various parts of Mexico as well as measurements in modern pottery and faked artifacts demonstrate the feasibility of using a commercial reader (Harshaw 2000) to authenticate ancient ceramics. Testing techniques are described in detail. Reading the TL stored in large quartz grains of known age is discussed. Consideration is given to the feasibilities of dating, detection of irradiated fakes, and the long-term integration of low environmental gamma radiation exposures by the use of these techniques. (auth)

18660 NON-EQUILIBRIUM URANIUM ABSOLUTE AGE DETERMINATION OF THE OCEANIC PHOSPHORITES. Baturin, G. N.; Merkulova, K. I.; Chalov, P. I. (Inst of Oceanology, Moscow). Geokhimiya; No. 5, 801-807(May 1974). (In Russian).

The ratio of $^{234}U/^{238}U$ activities in phosphorite nodules from the shelf of South-Eastern Africa is on the average equal to 1.163 + 0.005, in the nodules from the shelf of Chile 1.146 ± 0.005, in nodules from other regions the equilibrium or approximately equilibrium values. Geological and geochemical conditions of nodule formation are in accordance with the possibility of their non-equilibrium uranium dating. The absolute age of nodules from the two first regions is within the interval from 0 to 51 to 74 thousand years, of the other nodules it exceeds 1 mil. y. The ratio of $^{234}U/^{238}U$ IV activities in young nodules is similar to that of the total uranium but in ancient nodules it is lower than that of equilibrium uranium. (auth)

18661 RADIOCARBON AND TRITIUM EVIDENCE FOR DIRECT RAIN RECHARGE TO GROUND WATERS IN THE NORTHERN KALAHARI. Verhagen, B. Th.; Mazor, E.; Sellschop, J. P. F. (Witwatersrand Univ., Johannesburg). Nature (London); 249: No. 5458, 643-644(14 Jun 1974).

It is stated that radiocarbon and tritium data lead to the unambiguous conclusion that ground waters in the northern Kalahari are directly, and in some cases rapidly, recharged by rain. (UK)

18662 NEW K–Ar METHOD USING NEUTRON IRRADIATION. $^{40}Ar-^{39}Ar$ Age Determination. Saito, K.; Ozima, M. (Tokyo Univ.). Kagaku (Kyoto); 28: No. 11, 976-984(Nov 1973). (In Japanese).

The principle of $^{40}Ar-^{39}Ar$ method which was first developed by Merrihue and others in the early 1960s as an improved K–Ar method is explained. This method is useful in determining the age of some cosmic and terrestrial rocks. In this method, the ^{39}Ar produced by the fast neutron irradiation of samples and a cer-

tain standard sample is measured instead of the ^{40}K, and the extraction of ^{40}Ar is done by the stepped heating of the samples. The effects of Ar-loss or trapped Ar on age determination are eliminated by this method and more accurate age estimates for both terrestrial and cosmic rocks are obtained than with the ordinary K–Ar method. The results of an experiment on basalt obtained in the Mohole project are shown as an example of excess Ar resulting from the primary Ar trapped within the rocks. The excess Ar results in greater age values when the ordinary K–Ar method is applied. (JA)

18663 SPECIFICITY OF RADIOMETRIC DATING OF SEDIMENTARY ROCKS IN EUROPE. Odin, G. S. (Univ., Paris). Rev. Geogr. Phys. Geol. Dyn.; 15: No. 5, 523-532(Nov 1973). (In French).

The past few years have seen a renewal of the interest in the dating of sedimentary rocks, especially by glauconites. An attempt is made to analyze the difficulties of these measures, differing from those of high temperature rocks. The glauconites occur in the highly numerous epicontinental formations of Western Europe, where the stratotypes have been established. The problems raised by dating are linked both with the method employed and the mineralogical nature of the green granules. The glauconites constitute indeed a family of minerals showing a diversified behavior in relation to the factors which may modify their apparent age. The analysis of experimentation already carried out on our material has been conducted and a new experiment has been described as regards weathering. It is concluded from this study that if glauconites are frequent, those favorable to dating have to be carefully chosen, at least as long as further experimentation has not made it possible to get a better knowledge concerning the history of the employed chronometer. Problems related to the reliability of the absolute value results obtained remain to be solved. (FR)

18664 FISSION-TRACK AGES OF VOLCANIC ASHES IN A 200 M CORE SAMPLE IN LAKE BIWA, AREA, JAPAN. Nishimura, S. (Kyoto Univ.); Yokoyama, T. (Kyoto Univ.). Proc. Jap. Acad.; 49: No. 8, 615-618(Oct 1973).

The fission-track ages of the volcanic ash seams intercalated in Quaternary Ko-Biwako group, through which a 200 m boring was carried out in Lake Biwa area, are reported. These volcanic ashes are andesitic or rhyolitic in nature, containing pyroxenes, hornblend, biotite, quartz crystals with glass fragments or pumice grains. Age determination was done by using zircon crystals separated from three samples of the volcanic ash seams, each of which was taken from the respective three seams ranging in their depth from 37 m to 99 m below lake bottom. A Kyôto University reactor was used in this determination, and the neutron flux was obtained by the fission-track method of HASHIMOTO et al. The spontaneous fission-track density (cm^{-2}) ranged from 1.7 to 6.7×10^4; induced fission-track density (cm^{-2}) from 7.2×10^6 to 2.5×10^7; neutron dose (cm^{-2}) from 0.55 to 1.11×10^{15}, and fission-track age (yr B.P.) ranged from 8.0×10^4 to 1.8×10^5. The accuracy of this age value is stated as below 20%, considering sample errors. (JA)

18665 COMPARISON OF RADIOACTIVE GLASSES OF SCANDIUM AND IRIDIUM AS TRACERS IN SEDIMENT-TRANSPORT STUDIES. Krishanamurthy, K.; Rao, S. M. (Bhabha Atomic Research Center, Bombay). J. Hydrol.; 19: No. 3, 189-204(Jul 1973).

A systematic comparison was made of all important criteria for the selection of either ^{46}Sc or ^{192}Ir as a radioisotopic glass tracer for bed-load transport studies in rivers and estuaries. ^{46}Sc provides about 40% more count rate than ^{192}Ir for equal activities on the surface of the bed. It is concluded that except for ease of transportation to the worksite, ^{46}Sc appears preferable to ^{192}Ir. The use of ^{46}Sc provides higher detection sensitivity with less effect on the response due to the variations in the bed-detector distance. (Selec. Water Resour. Abstr.)

18666 RADIOAKTIVNYE I STABIL'NYE ISOTOPY V GEOLOGII I GIDROGEOLOGII. (Radioactive and Stable Isotopes in Geology and Hydrogeology). Gorbushina, L. V.; Tyminskii, V. G. Moscow; Atomizdat (1974). 104p.

The theoretical and experimental-methodical materials of interest for the solution of practical problems of geology and hydrogeology are examined. New data on methods for the use of natural radioactive and stable isotopes for the determination of the age of underground water are reported. The bases of the theoretical theses used during the determination of the age of underground water, the determination of the characteristics of the behavior of the different natural isotopes in the rock ⇔ water system, and their use for the study of the genesis of underground water of Sochi-Adler, Tashkent, Fergana, and other artesian basins are discussed. The possibilities of using different radiohydrogeochemical indicators for solution of such specific problems as burial of industrial wastes (particularly radioactive ones), prediction of earthquakes, and petroleum prospecting are analyzed. (tr-auth)

18667 DISTINGUISHING QUARTZ AND POLYMICT SANDSTONES FROM THE RATIO OF PS AND GAMMA SURVEYING. Kovalenko, D. E. (Combine of Ukrainian Geophysical Prospecting, Kiev). Neft. Gazov. Prom.; No. 3, 9-11(1973). (In Russian).

A method is described for distinguishing quartz and polymict sandstones from the amplitude ratio of PS and gamma surveying. Limiting values are presented for amplitudes of PS, gamma surveying and the relative parameter $\Delta U_{ps}/\Delta y_{\gamma}$ corresponding to the differences in the methods. Logical conditions are formulated for separating these values by means of computer. (SJR)

18668 EVALUATION OF THE RELIABILITY OF RESULTS IN DIFFERENTIAL INTERPRETATION OF GAMMA-LOGGING DATA. Borzyak, I. P. Izv. Vyssh. Ucheb. Zaved., Geol. Razved.; No. 3, 119-126(Mar 1974). (In Russian).

Errors in measurements of the gamma intensity and structural features of the borehole are presented as a series of unequally precise values of the metal contents, with the largest errors in the results for intercalculations with low metal concentrations, adjoining regions with high concentrations and vice versa. This must be considered in using the results of differential interpretation for solving prospecting problems. (tr-auth)

18669 DEPOSITION VELOCITY OF SULFUR DIOXIDE ON LAND AND WATER SURFACES USING A ^{35}S TRACER METHOD. Owers, M. J.; Powell, A. W. (Central Electricity Generating Board, Manchester, Eng.). Atmos. Environ.; 8: No. 1, 63-67 (Jan 1974).

The absorption of sulfur dioxide onto land and water surfaces was studied by means of field trials using SO_2 labelled with ^{35}S. Several measurements of the deposition velocity of sulfur dioxide were made on land and water surfaces, and the effect of a hedgerow was also investigated. From these results and other measurements of deposition velocity reported in the literature, it is concluded that the average deposition velocity for SO_2 over the British Isles is likely to be about 0.8 cm s^{-1} (referred to concentrations measured 20 cm above the surface). (auth)

18670 ISOTOPES IN GEOLOGY (METHODS AND APPLICATIONS). Pilot, J. Paris; Doin (1974). 176p. (In French).

Isotopic abundances are discussed together with the techniques used to measure them. The isotopic geochemistry of certain elements (hydrogen, carbon, oxygen and sulfur) and radiochronometric age measurements (argon and potassium–argon method; lead isotopes and U, Th, Pb methods; strontium and the Rb/Sr method; radiocarbon; radioactive disequilibria methods; fission track dating) are described. Finally, isotopic geochemistry and geological objects (hydrosphere, sediments, magmatic rocks, the earth in its environment etc ...) are discussed. An extensive bibliography is given. (FR)

18671 GROUNDWATER-TRACER TESTS IN THE PLEISTOCENE OF THE FREIBURGER BUCHT. Kaess, W. (Geologisches Landesamt Baden-Wuerttemberg, Freiburg im Breisgau (F. R. Germany)). Geol. Jahrb., Reihe C; No. 2, 119-151 (1972). (In German).

6 figs.; 16 refs.

Several tracers were comparatively used in the undisturbed pore groundwater. It was shown that besides uranine, eosine and detergents are also suitable for tracing in gravelly-sandy groundwater conductor. Salts undergo a cation exchange. To complement these tests, radiohydrometric measurements as well as a pump test were carried out. (auth)

18672 MEASUREMENTS OF DEUTERIUM AND OXYGEN-18 CONTENTS OF KARST WATERS. Batsche, H.; Moser, H.; Stichler, W. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg/Muenchen (F. R. Germany). Inst. fuer Radiohydrometrie). Geol. Jahrb., Reihe C; No. 2, 275-288(1972). (In German).

12 figs.; 7 refs.

After a brief review of the fundamentals and methodology of hydrological investigations with the aid of deuterium and oxygen-18 measurements, measuring results are given for karst regions. A report is presented in particular on our own measurements in the area of the Danube sinking holes, which are interpreted in connection with the tracer tests performed there, as well as with tritium and ^{14}C experiments. (auth)

Site Surveys

18673 (ARMS-68.6.6) AERIAL RADIOLOGICAL MEASURING SURVEY OF THE AREA SURROUNDING THE QUAD-CITIES STA-

TION, CORDOVA, ILLINOIS, JULY 1968. (EG and G, Inc., Las Vegas, Nev. (USA)). Jun 1974. 12p. (EGG-1183-1589). Dep. NTIS $4.00.

The aerial radiological measuring system (ARMS) was used to survey the area surrounding the Quad-Cities Nuclear Power Plant during July 1968, prior to reactor start-up. The survey measured terrestrial background γ radiation. A high-sensitivity detection system collected gamma spectral and gross-count data. The data were then computer processed into a map of a 625 square mile area showing isoexposure contours three feet above the ground. Exposure rates and isotopes identified are consistent with normal terrestrial background. (auth)

18674 (RLO-2225-T-24-15) COLUMBIA RIVER EFFECTS IN THE NORTHEAST PACIFIC: CHEMICAL AND GEOLOGICAL STUDIES. Report of Progress, May 1971–May 1974. Carpenter, R. (comp.). (Washington Univ., Seattle (USA). Dept. of Oceanography). May 1974. Contract AT(45-1)-2225. 38p. Dep. NTIS $5.00.

Research progress is reported on suspended particulate matter and chemical reactions between dissolved and particulate phases and ^{210}Pb and ^{210}Po in sediments off Washington Coast. Lists of publications giving details of the work are included. (MCG)

18675 (RLO-2225-T26-22) COLUMBIA RIVER EFFECTS IN THE NORTHEAST PACIFIC: BIOLOGICAL STUDIES. Report of Progress, June 1971–March 1974. Volume 1. Anderson, G. C.; Tennant, D. A. (comps.). (Washington Univ., Seattle (USA). Dept. of Oceanography). 15 Apr 1974. Contract AT(45-1)-2225. 26p. Dep. NTIS $4.50.

Investigations of communities of organisms, including the processes governing them, in the water column, in the seabed, and in the surf zone are reported. Studies concentrated on the algal products of organic matter, the subsequent consumption by the herbivorous zooplankton and its growth, and the fate of organic matter that reaches the seabed. (MCG)

18676 (SZS-148, pp 134-144) RADIATION PROTECTION AND GEOHYDROLOGICAL REQUIREMENTS FOR THE STORAGE OF RADIOACTIVE WASTES IN THE GDR. Richter, D.; Koerner, W. Mar 1973. (In German).

From German–Soviet working meeting on the question of radiation protection; Berlin, Germany (8 Jun 1972).

On the basis of an assessment of the amounts of radioactive wastes produced in the future disposal methods applicable in the GDR were evaluated from the safety and economic point of view. This evaluation led to the choice of an abandoned salt mine as ultimate storage site. A thorough safety analysis of the disposal site is performed. The hazards resulting from the interim storage of radioactive wastes at the nuclear plant site are evaluated on the basis of the geological and hydrological documentation necessary for construction permit. The requirements for such an evaluation are outlined. (auth)

Thermal Effluents

Refer also to abstracts 18624 and 20442.

18677 (DP-MS-74-46) MEASURING THE ENVIRONMENTAL EFFECTS OF THERMAL DISCHARGES. Harvey, R. S.; Randall, D. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1972. 15p. Dep. NTIS $4.00.

Savannah River biologists' expanded program at their new Thermal Effects Laboratory for evaluating the ecological consequences of warm water discharges from industrial processes and power plants is described. (auth)

18678 (MITSG-73-12) CHARACTERISTICS OF CONDENSER WATER DISCHARGE ON THE SEA SURFACE (CORRELATION OF FIELD OBSERVATIONS WITH THEORY). Doret, S. C.; Harleman, D. R.; Ippen, A. T.; Pearce, B. R. (Massachusetts Inst. of Tech., Cambridge (USA)). 26 Jun 1973. 126p.

Field measurements of the condenser water discharge plume at the Pilgrim Nuclear Power Station, Plymouth, Massachusetts, were conducted during 3 survey periods between Jan. and Apr. 1973. Horizontal temperature profiles of the plume were obtained for 2 water depths. Vertical temperature profiles were obtained in the far field to establish the ambient water conditions for the various survey periods. Plume centerline temperature reduction vs. distance and surface isotherm areas were determined from the field data. The field data collected were compared to an analytical model developed for prediction of the heat affected zone. (Pollut. Abstr.)

18679 (PB-224015) EFFECTS OF THERMAL DISCHARGES ON THE CHENA RIVER. (Alaska Univ., College (USA)). Apr 1973. 131p. NTIS $9.50.

Thesis.

The evaluation of several thermal discharges in Fairbanks, Alaska was carried out to determine their effects on the physical parameters of the Chena River, a typical sub-Arctic stream. In addition, the effectiveness of two discharge schemes at the main thermal source was compared. The use of a surface-spreading scheme at either source would result in a heat dissipation rate per unit area 2 to 10 times greater than use of a submerged jet. The amount of ice cover downstream from the discharges would be approximately 40% more using the submerged jet. The advantages of each discharge method are discussed and two alternative cooling methods are suggested. (Selec. Water Resour. Abstr.)

18680 RISE AND CONDENSATION OF LARGE COOLING TOWER PLUMES. Hanna, S. R. (Atmospheric Turbulence and Diffusion Lab., Oak Ridge, TN). J. Appl. Meteorol.; 11: No. 5, 793-799(Aug 1972).

Formulas are derived for the variation with height of the buoyancy, volume, and water vapor fluxes from large wet cooling towers. The simple formulas developed by Briggs are suggested for estimating plume rise, if the possibility of the release of latent heat is accounted for in the definition of the initial buoyancy flux. The probability of whether condensation will occur is sensitive to small variations in moisture content and temperature of the environment. Verification of the theory is hampered by the scarcity of adequate measurements of cooling tower plumes. (Pollut. Abstr.)

18681 NUMERICAL CLIMATE-CHANGE EXPERIMENTS: THE EFFECT OF MAN'S PRODUCTION OF THERMAL ENERGY. Washington, W. M. J. Appl. Meteorol.; 11: No. 5, 768-772(Aug 1972).

A set of general circulation model experiments on possible climatic changes caused by man's generation of thermal energy or pollution is described. Three experiments were carried out: one in which a small initial error was introduced; one in which the expected ultimate levels of thermal energy generation were added; and one in which a negative amount of energy was added. The same results were obtained in all 3 experiments, indicating that the thermal pollution effect is probably small compared to natural fluctuations of the model. Some limitations of the model for inferring the proper climatic-change response are discussed. (Pollut. Abstr.)

18682 VERTICAL MIXING OF HEATED EFFLUENTS IN OPEN-CHANNEL FLOW. Schiller, E. J. Iowa City, IA; University of Iowa (1973). 163p. University Microfilms Order No. 74-7429.

Thesis (Ph. D.).

The extensive use of rivers as a sink for heated effluents from thermal power plants has created widespread concern for the aquatic life in these waterways. The present study is an attempt to determine relevant parameters that can be used in the prediction of vertical mixing of heated surface effluents in the far-field mixing region. A set of laboratory flume experiments was conducted which covered a range of flows from well mixed to nearly stable stratified conditions. The velocity and depth of flow, as well as the temperature difference and discharge ratio between ambient and effluent flows were varied to simulate the range of conditions commonly encountered in practice. Temperatures were recorded downstream by mobile thermistors, which were directly coupled to an IBM-1801 Digital Data Acquisition System. Velocity measurements were also taken for selected runs. From the data together with an analysis based on the convection-diffusion equation, it is possible to determine: the distance for nearly complete mixing; a bulk mixing coefficient, K_y, for moderately and rapidly mixing flow; and the vertical distribution of the overall vertical heat transfer coefficient at cross sections downstream. The buoyancy effects were absorbed into the transfer coefficient. The less dense water inhibits mixing near the surface, and creates reduction in mixing throughout most of the depth for the more stratified flows. For the rapidly mixing flows, the vertical heat transfer coefficient was found to agree closely with the turbulent momentum transfer coefficient. Finally, for selected runs, predictions of the downstream temperature profiles were obtained using a finite difference representation of the steady state convection-diffusion equation. The predicted profiles were found to agree closely with the experimental ones. (Diss. Abstr. Int., B)

18683 COLUMBIA RIVER THERMAL EFFECTS STUDY: REACTOR EFFLUENT PROBLEMS. Becker, C. D. (Battelle memorial Inst., Richland, WA). J. Water Pollut. Contr. Fed.; 45: No. 5, 850-869(May 1973).

Thermal studies of the environmental impact of heated discharges from thermoelectric power plants, nuclear and fossil-fueled, are passing through a decisive phase. The Columbia River (Wash.) thermal effects study utilized the expertise, programs, and facilities of three agencies in order to focus on thermal problems peculiar to the Columbia River during 1968 to 70. The studies dealt with (a) spawning populations of adult and migration timing of juvenile chinook salmon, (b) sonic tracking of adult salmonids past heated reactor discharges, (c) thermal resistance of adult salmonids, (d) passage of juvenile salmonids through reactor discharge plumes, (e) equilibrium loss and ecological death of juvenile salmonids from thermal shock, (f) thermal shock and predation on juvenile salmonids, (g) food and feeding of juvenile chinook salmon, (h) rearing temperatures and artificial propagation, (i) gas-bubble disease of salmonids, (j) columnaris disease in Columbia River fish, and (k) effects on Columbia River invertebrates. (Selec. Water Resour. Abstr.)

Chemical Effluents

Refer also to abstracts 18363, 18634, 18636, 20539, and 20571.

18684 (LA-5559) ECOLOGICAL CONSIDERATIONS OF DEPLETED URANIUM MUNITIONS. Hanson, W. C. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1974. Contract W-7405-eng-36. 7p. Dep. NTIS $4.00.

Ecological consequences of depleted uranium (DU) released to the environment as a result of military use of DU munitions were appraised by reviewing pertinent literature. Estimates were based on ecosystem responses to natural uranium, which is more soluble and more toxic than DU. It was concluded that the major ecological hazard from expended uranium munitions will be chemical toxicity rather than radiation. The alloy nature of the munitions will substantially decrease the mobility of DU and mitigate the problem. However, the ecological aspects of the chemical toxicity of DU in terrestrial ecosystems is expected to be a major consideration of expended munitions. (auth)

18685 (LA-5634-PR) DEVELOPMENT OF AIR-SAMPLING TECHNIQUES. LASL Project R-059. Progress Report, October 1, 1973–March 31, 1974. Campbell, E. E.; Wood, G. O.; Anderson, R. G. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1974. Contract W-7405-eng-36. 8p. Dep. NTIS $4.00.

Thermal desorption-gas chromatographic analysis of formaldehyde collected on alumina has been abandoned in favor of a colorimetric method. This modified chromotopic acid method has been found to have much greater sensitivity and specificity and acceptable precision and accuracy. Capacity and breakthrough measurements have been made for a selected alumina sorbent by sampling air containing formaldehyde. As a result, a sampling tube has been designed capable of sampling for up to 1600 s (27 min) under extreme humidity conditions. Additional breakthrough measurements have been done for aniline, o-toluidine, and xylidine in a high-humidity atmosphere sampled with 45/60-mesh silica gel. From these results a new sampling tube has been designed for sampling aromatic amines. The precision of the total sampling and analysis method has been determined. The accuracy of the method was also confirmed by comparison with an independent sampling and analysis procedure. Approximately fifty sorbents were screened for methylamine capacity before selecting the same silica gel used for aromatic amines. An efficient desorption procedure was developed for methylamine collected on silica gel. An analytical method of good precision was also developed. Preliminary work has begun with other aliphatic amines. Six charcoals supplied by NIOSH were tested for benzene and carbon tetrachloride adsorption capacity. Charcoal from an MSA Organic Vapor Respirator Cartridge was tested for benzene capacity at two temperatures and the heat of adsorption was calculated. A plug has been developed for holding sorbent sections in sampling tubes which has negligible pressure drop. (auth)

18686 ENERGY AND ENVIRONMENT. Int. J. Environ. Stud.; 3: No. 4, 301-306(Sep 1972).

The acceptability of nuclear fuels as an energy source is discussed. The world today is faced with the increasingly difficult dilemma of generating sufficient energy, especially electric energy, to satisfy its rapidly growing needs while at the same time restoring and preserving its natural environment. Among the various alternatives, the fossil fuel and nuclear sources are the only major possibilities for meeting the requirements during the next few decades. The nuclear source has the advantages of minimal air pollution and almost unlimited fuel resource availability when the breeder reactor becomes available. The characteristic environmental impact of the nuclear source can be made acceptable under a proper program of management. (Pollut. Abstr.)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 18413, 18619, and 19440.

General Detectors and Monitors

Refer also to abstracts 18825, 18917, and 20167.

18687 (AED-Conf-74-044-006) SECONDARY ELECTRON DETECTORS FOR THE DETECTION OF HEAVY IONS. Clerc, H. G.; Lang, W.; Lehmann-Carpzov, W.; Schmidt, K. H.; Wohlfarth, H. Mar 1974. 8p. (In German). INIS.

From exhibition and experts' meeting "Nuclear Technology"; Frankfurt am Main, F. R. Germany (18 Mar 1974).

6 figs.; 9 refs. With abstract.

A detector is described which permits the determination of the atomic number of high-energy heavy ions. It is based on the emission of secondary electrons originating from the passage of heavy ions through carbon foils. The secondary electrons are focused by electrostatic lenses on a surface barrier detector. Measurements show that the secondary electron yield is proportional to the differential energy loss. The atomic number of the ions is then obtained by measuring the velocity of the ions. An arrangement with 102 foils gave the following results: The fission fragments of the light group of a ^{252}Cf-source could be classified according to elements. The line width (FWHM) of the secondary emission signal is 2.4% at Z = 44 and 0.8 MeV/amu. The mass per unit area of the detector coating is small (500 $\mu g/cm^2$) and the detector is insensitive to radiation damage. With a 100% efficiency it delivers high, background-free signals (400 MeV) with short rise time (approximately 2 ns). Operation with high counting rates (MHz range) is possible. (orig./RW)

18688 (CONF-730804-P2, pp 808-813) PRESSURE, CUTOFF RIGIDITY, AND TIME DEPENDENCE OF THE ATTENUATION COEFFICIENT OF A NEUTRON MONITOR. Raubenheimer, B. C.; Stoker, P. H. (Potchefstroom Univ. for C.H.E., South Africa). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Using data obtained during 1969 and 1971 with an airborne neutron monitor, the pressure, cutoff rigidity and time dependence of the attenuation coefficient of the neutron monitor were investigated. Special attention was given to the experimental and statistical errors introduced by the measurements and analyses. It was found that these results, although more comprehensive than any previous results, confirmed these results as a whole. It is shown that any differences are mainly due to the different pressure regions covered by the various experiments. The pressure, cutoff rigidity and time dependence of the attenuation coefficient are discussed and compared with other results and finally incorporated in a single equation for use by research groups, especially in determining the time variation of the attenuation coefficients. (auth)

18689 (CONF-730804-P2, pp 814-819) EFFECTS INFLUENCING THE ATTENUATION COEFFICIENT OF A NEUTRON MONITOR. Raubenheimer, B. C.; Stoker, P. H. (Potchefstroom Univ. for C.H.E., South Africa). 1973.

From 13 international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

An investigation of the effect of stopping muons on the attenuation coefficient of the neutron monitor shows that this effect may be neglected since the transformation to a vertical attenuation coefficient diminished this effect by about 80 percent. This is due to the fact that stopping muons are mainly incident from non-vertical directions. When more accurate data on stopping muons become available, this effect may be investigated more accurately. From this analysis it is confirmed that the specific or partial attenuation coefficient is independent of the solar activity. This experimentally derived coefficient also corresponds well with results obtained from Monte Carlo calculations and can be used to calculate the pressure variation of the yield function of the nuclear active particles registered by a neutron monitor. (auth)

18690 (CONF-730804-P2, pp 878-882) UNDERGROUND OBSERVATION OF COSMIC-RAYS WITH MULTI-DIRECTIONAL LARGE AREA MUON TELESCOPE AT MISATO. Mori, S.; Yasue, S.; Ichinose, M.; Sagisaka, S.; Akabane, S. (Shinshu Univ., Matsumoto, Japan). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

A multi-directional muon telescope having a large area of 16 m^2 is now under construction in a new tunnel at Misato Village in Nagano Pref., Japan. The new tunnel is situated at a vertical depth of 30 mwe, its area being 50 m^2, and a shape of the ground overhead is nearly spherical. The telescope consists of two layers of plastic scintillators separated by 152 cm. The layers are sub-divided into 16 units of the detectors of 1 m^2 area, so five different directional intensities for North (N), South (S), East (E) and West (W) as well as for Vertical (V), can be measured simultaneously, and supplemented with four more inclined directional measurements. By utilizing difference vectors such as N-E, S-E, W-E and V-E, effects due to atmospheric conditions and also isotropic intensity variations can be reduced. Counting-rates are about 30×10^4/hr for V, $\sim 18 \times 10^4$/hr for S, $\sim 15 \times 10^4$/hr for N, E and W. Full observations will be started from this August. (auth)

18691 (FEI-409) DETERMINATION OF THE ENERGY THRESHOLD FOR THE IDENTIFICATION OF PARTICLES IN ACCORDANCE WITH THE FORM OF THE SCINTILLATION SIGNAL. Nesterenko, V. S.; Chubarov, S. I.; Shchadin, N. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 8p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

A method for the determination of the energy threshold for the identification of particles in accordance with the scintillation signal is examined. The method is based on the evaluation of the form parameter by the method of maximum likelihood. Calculation formulas for the determination of the energy threshold were obtained for the two-component model of the scintillation signal. (tr-auth)

18692 (IFTJ-48/E) DYNAMIC DIFFERENCE CIRCUIT. Lankosz, M.; Lacki, E. (Institute of Nuclear Physics and Techniques, Krakow (Poland)). Feb 1974. 20p. (In Polish). Dep. NTIS (US Sales Only) $4.00.

A dynamic difference circuit for continuous subtraction of numbers of counts proceeding from two separate radiometric channels is presented. Construction and operation of circuit separate blocks are described. An error analysis of counts difference measurements was performed. Results of theoretical calculations were found to be in good agreement with experimental data. (auth)

18693 (IS-T-636) DETERMINATION OF THE NEUTRON ENERGY DISTRIBUTION FROM 8 TO 20 MeV IN A FAST FLUX FACILITY BY USING (n,2n) REACTIONS AS THRESHOLD MONITORS. Gill, R. L. (Ames Lab., Iowa (USA)). Jul 1974. Contract W-7405-eng-82. 46p. Dep. NTIS $5.50.

Thesis.

The threshold monitors chosen were ^{169}Tm, ^{93}Nb, ^{127}I, ^{75}As, ^{19}F, ^{89}Y, ^{64}Zn, and ^{58}Ni. The calibration of the detectors, irradiation conditions, counting procedure, and spectra unfolding method are described; and results are presented and discussed. (WHK)

18694 (KHFTI-72-8, pp 22-24) EXCLUSION OF IMPROPER MEASUREMENTS WHILE PROCESSING PHYSICAL EXPERIMENT DATA. Koltunov, I. A.; Lyubarskii, G. Ya.; Rovinskaya, A. M. 1971. (In Russian).

The problem of the exclusion of poorly measured points during film processing of nuclear experiments was examined and a processing method based on the principle of maximum probability is proposed. The proposed method itself represents an iterating process where the weights of the experimental points, found as a result of the foregoing step, were used for preparing calculated curves, giving the best approximation. The weights of the points in the succeeding approximations were determined from the distance of the point from this curve. The characteristics of the proposed algorithm are described. (tr-auth)

18695 (KHFTI-72-8, 49-64) AUTOMATIZATION OF PROCESSING NUCLEAR EXPERIMENT DATA WHEN USING PHOTOEMULSIONS. Linetskii, A. P. 1971. (In Russian).

The results obtained at the Physics-Technical Institute in the automation of nuclear experiments using photoemulsions are described. A description is given of the mathematical control of the semiautomatic microscopes PPM-1 and "Arkhimed" and the program for the processing and simulation of multiparticle nuclear reactions using the Dnepr-1 and M-220 computers. (tr-auth)

18696 (KHFTI-72-8, pp 139-147) MEASURING IONIZATION ON TRACKS BY MEANS OF THE TV SCANNING. Kuz'michev, M. A.; Rutkevich, N. Ya. 1971. (In Russian).

The individual solutions and the technical considerations arising during the development of television semiautomatic devices for the structural measurement of tracks in photoemulsions are described. The functional circuit of a semiautomatic device and the principal circuits of its individual units are given. The results of tests of the device on standard tracks of different widths are reported. (tr-auth)

18697 (LA-5617-MS) DELAY LINE READOUT OF ANODE PLANES IN PROPORTIONAL CHAMBERS. Lee, D. M.; Sobottka, S. E.; Thiessen, H. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Apr 1974. Contract W-7405-eng-36. 4p. Dep. NTIS $4.00.

Simple delay lines have been developed for reading out active anode wire locations in multiwire proportional chambers. Anode wire positions are readout using commercial fast logic and time digitization apparatus with no special electronics required. (auth)

18698 (NMAB-287) MATERIALS FOR RADIATION DETECTION. (National Materials Advisory Board (NRC), Washington, D. C. (USA)). Jan 1974. 362p.

The available information (complete through 1971) on detectors for the electromagnetic radiation spectrum in the wavelength range 10^{-10} cm is surveyed. The detectors are divided according to wavelength range into four groups: (1) sensors for x-rays and gamma-rays; (2) sensors for ultraviolet, visible and near-infrared radiation; (3) detectors for infrared radiation from 2 to 200 micrometers; and (4) detectors for far-infrared and millimeter wave radiation. Progress on a broad front in the understanding of materials and the production of devices useful in radiation detection is recognized, but limitations both in the quality and properties of available material and in fundamental understanding require intensive effort in a number of areas. Conclusions and recommendations are made for (a) fundamental studies, (b) research on specific materials with definite applications, and (c) the establishment of two groups for continuing review and further study of specific problems. Priorities have been assigned to the various recommendations, based on the Committee's judgment of the importance of the required need and the probability of success in a research and development effort aimed at satisfying that need. (auth)

18699 (RFP-2303) POWER SUPPLY MODULE. Martin, B. E. (Dow Chemical Co., Denver, Colo. (USA). Rocky Flats Div.). 20 Jun 1974. Contract AT(29-1)-1106. 6p. Dep. NTIS $4.00.

In developing radiation detection instrumentation at Rocky Flats Division, a system concept using plug-in modules was planned. Losses of operational time due to maintenance are drastically reduced as a malfunctioning module can be replaced within minutes. Versatility is another advantage of the modular concept. A particular module can be used in many different system designs. A significant cost savings in system development can also be realized. The power supply is housed in a two-wide Nuclear . Instrumentation Bin (NIM-BIN) module. It provides +12 volts DC for electronic circuitry and 2.5 volts AC for light-emitting diode (LED) displays. The 12-volt DC regulator, an integrated circuit (IC), is packaged in a TO-3 case featuring low cost and high reliability. The power supply is used in a gross alpha-detection system and a medical wound-counting system. (auth)

18700 SCC-750W SHIMADZU WHOLE BODY SCANNER AND ITS ATTACHMENTS. Ueyanagi, H.; Nakanishi, S.; Toda, M.; Maruoka, F.; Noda, I. (Shimadzu Seisakusho Ltd., Kyoto). Shimadzu Hyoron; 30: No. 4, 199-207(Dec 1973). (In Japanese).

By the development of several new radiopharmaceuticals for radioisotope scanning, the whole body scanning of bone has been recently recognized as one of the effective methods for clinical diagnosis in nuclear medicine. The performance of the newly developed Shimadzu Whole Body Scanner SCC-750W and its attachments is described, and a discussion on scanning collimator characteristics is included. (auth)

18701 (SZS-148, pp 107-111) DETECTION OF LOW ENERGY PHOTON EMITTERS IN THE NATIONAL CENTRE FOR RADIATION PROTECTION. Loessner, V. Mar 1973. (In German).

From German-Soviet working meeting on the question of radiation protection; Berlin, Germany (8 June 1972).

The design of a special monitoring system for sensitive in vivo detection of low-energy photon emitters is described. Especially the high-damping Faraday cage, the whole-body counter shielding, the optimized detector system and the development of methods for pulse-shape discrimination are described in detail. A sandwich scintillation detector and a proportional counter are used. (auth)

18702 (SZS-148, pp 112-122) APPLICATION OF SILICON SEMICONDUCTOR DETECTORS FOR RADIATION MONITORING IN RADIATION PROTECTION AND BIOMEDICAL EXAMINATIONS. Manchuk, V. A.; Petushkov, A. A.; Pryakhin, Yu. F.; Sobol, N. V. Mar 1973. (In Russian).

From German-Soviet working meeting on the question of radiation protection; Berlin, Germany (8 June 1972).

Studies on radiometric and dosimetric parameters of silicon semiconductor detectors have shown that in registrating alpha particles with surface-barrier detectors the counting rate is proportional to the detector surface and is 0.25 (±10%) c/h.cm^2. An alpha spectrometer working on this principle allows measurements of samples with activity concentrations as low as 10^{-14} Ci/g. For in vivo measurements of beta emitters in body cavities and surface tissues a counting device equipped with a lithium-drifted silicon semiconductor detector was developed. Counters with semiconductor detectors are also applied in x-ray and gamma dosimetry. (auth)

18703 (CONSTRUCTION AND PHYSICAL PARAMETERS OF MULTISCAN WHOLE-BODY SCANNER. Silar, J.; Smidova, M.; Vacek, J. (Charles Univ., Prague). Cas. Lek. Cesk.; 112: No. 15, 458-461(13 Apr 1973). (In Czech).

The construction of a commercial whole-body scanner which permits the scanning of the distribution in the human body of the activity of gamma emitters having an energy of up to 1.3 MeV is described. Results are presented on the measurement of physical parameters affecting the scanning possibilities of Multiscan, model No. 602, produced by Cyclotron Corporation. The resulting radiometric parameters are listed. The results of measurements show that the device can be used in the whole-body scanning of the distribution of the activity of gamma emitters applied in routine procedures, such as 100 μCi of ^{85}Sr, with a position resolution of 25 to 50 mm in a tissue layer in a height of up to 100 mm above the Multiscan table. (Nuclear Sci. Abstr. Czeck.)

18704 NEW ETCHING TECHNIQUE FOR DAMAGE TRACK DETECTORS. Tommasino, L.; Armellini, C. (CNEN, Casaccia, Italy). Radiat. Eff.; 20: No. 4, 253-255(1973).

From 7th international colloquium on corpuscular photography and visual solid detectors; Barcelona, Spain (Jul 1970).

Etching reagents rapidly diffuse in the fine channels produced in insulators by the passage of the charged particles. Conductive channels are thus produced, which penetrate the insulating foils. By applying H.V. square or sinusoidal waveforms through the irradiated insulator, the current and treeing phenomena produced in the conductive paths increase the preferential chemical etching of the tracks. This type of etching makes it possible to enlarge the damage tracks at will and in some cases to increase the sensitivity of damage track registration. Furthermore the damage trails produced by heavy ions provide a successful tool to study treeing mechanisms on electrical insulators. (auth)

18705 RADIOLUMINESCENCE IN LARGE SINGLE CRYSTALS OF CADMIUM SULPHIDE DOPED WITH TELLURIUM. Bateman, J. E.; Ozsan, F. E.; Woods, J.; Cutter, J. R. (Durham Univ., Eng.). J. Phys., D (London); 7: No. 9, 1316-1328(11 Jun 1974).

The growth of large single crystals of cadmium sulfide doped with tellurium, CdS:Te, is reported. These crystals have a high luminescence efficiency for electron-hole recombination at isoelectronic tellurium traps. Their properties are very similar to those of platelet crystals grown in a continuous flow process. Single-photon counting techniques have been used to measure the decay of the luminescence excited by 5.5 MeV α-particles. Thermal quenching is also discussed. It is shown that a combination of a CdS:Te crystal and a silicon photodiode provides a new scintillation counter for γ ray spectroscopy. (auth)

18706 SCINTILLATION CAMERA WITH IMPROVED LIGHT DIFFUSION. Martone, R. J.; Goldman, S. C.; Wolczek, W. (to Picker Corp.). US Patent 3,814,938. 4 Jun 1974. Filed date 10 Jul 1972. 14p.

A scintillation camera of the multiple phototube type is described. A thin light pipe and masks are employed to diffuse the light so that the camera operates on a principle of light diffusion rather than phototube "viewing" as described in the prior art. The configurations of the masks are selected in accordance with the characteristics of the crystal and associated phototubes. (Official Gazette)

18707 DEVICES AND METHODS FOR MEASURING LOW ACTIVITIES OF RADIOACTIVE PREPARATIONS. Dement'ev, V. A.; Furman, A. O. pp 188-194 of Primenenie Izotopov i Yadernykh Izluchenij v Sel'skom Khozyajstve. Razdel 2. Primenenie Izotopov v Rastenievodstve i Zemledelii. Moscow; Atomizdat (1971). (In Russian).

The principles of the construction of radiometric installations for the measurement of preparations with small volume and specific activity were studied. Basic results were obtained by analysis of the statistical laws of the process for the registration of a weak flux of nuclear particles. The conclusions obtained were used experimentally during the development and study of two types of installations for the measurement of low-activity preparations from the hard β radiation. (tr-auth)

18708 MANUFACTURE OF LITHIUM-DRIFTED SILICON DETECTORS. Jao, S. S. (Inst. of Nuclear Energy Research, Taipei, Taiwan); Chang, H. H. Nucl. Sci. J. (Taiwan); 8: No. 3-4, 41-49 (Dec 1971).

A method for fabricating lithium-drifted silicon Si(Li) detectors is presented. An effort has been made to offer a technique in sufficient detail to enable others to reproduce easily our results. The energy resolution obtained for these detectors with active area of about 5 cm^2 and thickness of 1.5 to 3.5 mm is 3.6 keV for 625 keV internal conversion electrons from ^{137}Cs. (auth)

18709 FLOW TYPE GM. Counter Used for Detecting Released ^{85}Kr. Lukac, P.; Jesenak, V.; Varga, S. (Slovak Technical Univ., Bratislava). Jad. Energ.; 20: No. 5, 167-168(May 1974). (In Czech).

The device used for studying the thermal release of ^{85}Kr from solid matters and its detection is described. The new flow-type counter working in the Geiger–Mueller region was constructed for detection of released radioactive krypton. Argon is used as the working gas for the detector. Vapors of ethyl alcohol are used as the quenching agent. (auth)

18710 GOLD–SILICON SURFACE-BARRIER DETECTOR. Chang, H. H.; Jao, S. S.; Sheu, J. P.; Shyu, Y. M. (Inst. of Nuclear Research, Lungtan, Taiwan). Nucl. Sci. J. (Taiwan); 9: No. 1-2, 22-29(Jun 1972).

Gold silicon surface-barrier detectors have been fabricated with n-type silicon wafers of 100, 600, and 2000 ohm-cm respectively. The best counter with 25 mm^2 sensitive area from 100 ohm-cm wafer has 15 keV energy resolution for ^{241}Am 5.47 MeV alpha particles. A table with specifications of the manufactured detectors is also given. (auth)

18711 PROPORTIONAL COUNTER FOR THE SOFT X RAY REGION FOR THE EXPERIMENTS IN SATELLITES. Moucka, L.; Farnik, F.; Valnicek, B. Jad. Energ.; 20: No. 3, 82-5(Mar 1974). (In Czech).

The structure and the properties of a beryllium-windowed proportional counter for the X ray region for 1 to 15 keV are described. The chamber was filled with the mixture of argon and carbon dioxide gases. Counting efficiency, resolution, counter lifetime and other characteristics are discussed. (auth)

18712 IN VIVO QUANTITATION OF RADIOACTIVITY USING THE ANGER CAMERA. Graham, L. S.; Neil, R. (California Univ., Los Angeles). Radiology; 112: No. 2, 441-442(Aug 1974).

From 59th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (25 Nov 1973).

Phantoms containing radioactive sources and rabbits injected with radionuclides were imaged and corrections made for attenuation and location within the attenuating medium. Errors appear to be less than 10% for ^{131}I and ^{111}In without the use of an additional correction factor. Errors for plane sources of ^{99m}Tc were somewhat greater than 10% although the phantom and rabbit studies indicated smaller errors. (auth)

18713 SCINTILLATION COUNTING SYSTEMS AND COMPONENTS. Ting, P.; Litle, R. L. (to Beckman Instruments Inc.). US Patent 3,816,743. 11 Jun 1974. Filed date 30 Aug 1971. 8p.

Scintillation counting systems employing a permanently connected flowpath for introducing and removing mixtures of fluid scintillator and sample must be protected against admission of light and ultraviolet rays to the scintillation sensor through the flowpath. The invention provides an improved protection arrangement including a light trap which is a trap for light and a conductor for fluids. The use of two of those light traps, one upstream and one downstream from the sensor, are combined with a novel mixer to provide a continuous flow monitoring counter in which mixing of sample scintillator and their introduction to the mixer can be visually monitored without introduction of outside light to the sensor. (Official Gazette)

18714 CONTAMINATION MEASURING INSTRUMENTS FOR PERSONAL MONITORING. Gebauer, H. (Frieseke und Hoepfner G.m.b.H.; Erlangen, Ger.). G-I-T(Glas- Instrum.-Tech.) Faschz. Lab.; 17: No. 13, 1377-1381(Dec 1973). (In German).

Currently available commercial contamination measuring instruments are discussed. A portable contamination monitor; a hands, shoes, clothes monitor; a whole-body counter; and an automatic laundry monitor are described. (GE)

18715 USE OF SOLID STATE NUCLEAR TRACK DETECTORS FOR LOW LEVEL α-COUNTING. Wipawin, W. T.; Thomas, B. J.; Khan, H. A. (Univ. of Birmingham, Eng.). Int. J. Radiat. Phys. Chem.; 6: No. 3, 203-210(Jun 1974).

Being insensitive to high doses of light-charged particles, γ-rays and other electromagnetic radiations, solid state nuclear track detectors (SSNTDs) are suitable for application to low level α-counting. Tests carried out on a number of plastic SSNTDs and nuclear emulsions in order to study their various track registration properties are described. Attempts were also made to enhance the "signal to noise" ratio by making use of U. V. radiations and by dyeing the etched tracks. Both thick and thin alpha sources were employed during these studies. Also, LR-115 (a cellulose nitrate) foil was used in the estimation of the concentration and distribution of lead in teeth. (auth)

18716 AUTOMATED METHOD FOR THE EVALUATION OF NONFOCUSED COLLIMATOR PERFORMANCE IN WATER MEDIUM. Bosnjakovic, V.; Bennett, L. R. (Univ. of California, Los Angeles). J. Nucl. Med.; 15: No. 8, 679-680(Aug 1974).

An automatic method for scanning the efficiency distribution of single-bore, nonfocused collimators in a water medium is presented. The scintillation probe with the collimator to be studied is kept stationary but connected to the scanner display while the scanner arm is used to move the point source of radioactivity transversely and longitudinally through a water phantom within the field of view of the collimator. (auth)

18717 HIGHLY SENSITIVE MONITORING SYSTEM FOR LIQUID EFFLUENTS WITH ALPHA RADIOACTIVITY. Kato, J. (Power Reactor and Nuclear Fuel Development Corp., Tokyo); Endo, K.; Yamaguchi, K.; Kusudo, T.; Matsuno, K. Fuji Jiho; 46: No. 7, 625-630(Jul 1973). (In Japanese).

A liquid effluent monitoring system has been developed for a fast experimental reactor. The system is capable of detecting the α activity of U and Pu, while conventional monitors have the ability for detecting β (γ) activity in liquid effluents. Since the α particle has a short range, highly sensitive measurement can not be achieved for liquid samples. So, the measurement is carried out by means of evaporation to dryness, utilizing the high melting points of U and Pu. The detector is a large area gas-flow ionization chamber, in which PR gas is applied for α detection and Q gas for β (γ) detection. It is required that the sample of 1,000 cc be dryed to about 35 min. Either overheating or insufficient heating must be avoided. The α-detector is cooled with a blower because it is placed near high-temperature sample plates. Maximum detection sensitivity was approximately 1.2×10^{-8} μ Ci/cc for α particles and approximately 3.0×10^{-6} μ Ci/cc for β (γ) ray. (JA)

Radiation Dosimeters

Refer also to abstract 18946.

18718 (AED-CONF-73-482-8) LONG-TERM CONSTANCY TEST OF IONIZATION DOSEMETERS USING ^{60}Co RADIOACTIVE DECAY. Rosenow, U.; Frischkorn, R. (Goettingen Univ. (F. R. Germany). Frauenklinik und Poliklinik). 1973. 4p. (In German). ZAED.

From fourth scientific meeting of the Deutsche Gesellschaft fuer Medizinische Physik; Homburg/Saar, Federal Republic of Germany (4 Oct 1973).

A method is described which permits the longtime control of ionization chamber dosemeters. Deviations from the expected value are easily detected and long-term trends in the dosemeter sensitivity can also be confirmed. (INIS)

18719 (JAERI-M-5578) DOSE AND FLUENCE MEASUREMENTS. Bingo, K.; Fujita, M. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 33p. (In Japanese). NTIS (US Sales Only).

The Third IAEA Intercomparison of Nuclear Accident Dosimetry Systems was conducted at Vinca, Yugoslavia, on May 14–25, 1973. Teams from thirteen countries compared their nuclear accident dosimetry systems by simultaneously exposing dosimeters to a mixture of neutron and gamma radiation produced by a reactor at Vinca. The reactor was operated two times by changing the power. The JAERI team made measurements both in free air and on phantoms with nuclear accident dosimeters and personnel dosimeters. The energy spectra for fast and intermediate neutrons were estimated to be $\sqrt{E}\exp(-0.75E)$ and $1/E^{1.1}$, respectively. The values obtained for neutron kerma of standard man tissue in free air were 13.5 and 80 hectoerg/g for the two operating conditions, respectively, and those of gamma ray dose were 50 and 263

rads, respectively. Surface absorbed doses of 17 and 106 rads due to heavy recoil particles were obtained for the phantom facing the reactor in the two irradiating conditions, respectively. The values of dose and neutron fluence estimated were compared with those reported by other teams. (auth)

18720 (RT/PROT-(74)1) SOME PROPERTIES AND PRACTICAL APPLICATIONS OF SINTERED BERYLLIUM OXIDE AS THERMOLUMINESCENT MATERIAL IN RADIATION DOSIMETRY. Benincasa, G.; Ceravolo, L.; Scarpa, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). Jan 1974. 42p. Dep. NTIS (US Sales Only) $5.25.

The main dosimetric characteristics undoped beryllium oxide as a thermoluminescent material were investigated. In the dosimetry of x-and γ-rays some advantages of BeO over other TL materials are low cost, chemical inertness, resistance to mechanical shocks, high sensitivity, good reproducibility of response, low fading, absence of low-temperature peaks, and moderate energy dependence. In the dosimetry of mixed fields of neutrons and gamma radiation, beryllium oxide could be very useful for measuring the gamma component with reasonable accuracy. The possible use of BeO discs as postal dosimeter in dose intercomparison has also been studied. In this connection beryllium oxide Thermalox 995 discs have been used in the 2nd dose intercomparison organized by EULEP. (auth)

18721 (SAND-74-5089) APPLICATIONS OF THE POLY-(HALO)STYRENE DOSIMETER SYSTEM IN PULSED AND STEADY STATE ENVIRONMENTS. Bishop, W. P.; Snow, E. T.; Royer, E. P.; Benson, J. L.; Plimpton, J. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1974. 13p. (CONF-740715-2). Dep. NTIS $4.00.

From international radiation research congress meeting; Seattle, Washington, USA (14 Jul 1974).

The poly(halo)styrene dosimeter system is described. The material consists of a polystyrene matrix with para substituted halogen and doped with 3% malachite green methoxide dye. When exposed to ionizing radiation this dye moiety undergoes a change from a colorless to a colored ion form. The spectrum of the colored material exhibits maxima at 630 and 430 nm. The change in optical density at both peaks is proportional to the absorbed dose and can be measured with a spectrophotometer or a densitometer. The material is sensitive in the Megarad region, is highly reproducible, has a long lifetime and a relatively short development period. It is insensitive to radiation quality, water, and most common gases. The material response has also been shown to be independent of dose rate up to 10^{15} R/sec. (WHK)

18722 NEUTRON DOSIMETRY FOR RADIOBIOLOGICAL PURPOSES. Parmentier, N.; Chemtob, M.; Ricourt, A. (CEN, Fontenay-aux-Roses, France). Ann. Phys. Biol. Med.; 7: No. 3, 95-122(1973). (In French).

The neutron dose absorbed by thin tissue samples in neutron fields can be determined either by a direct method or an indirect method. The indirect method involves measuring the fluence and neutron spectra at a point in the beam. Although this method is not discussed in the text, the results obtained are used for comparison purposes. In the indirect method, ionization chambers or tissue equivalent detectors are used to determine the dose absorbed by a thin tissue sample exposed at the point under consideration. The response of the chamber at different energies per unit of fluence is compared with the result published in I.C.R.U. Report no. 13, and the F. S. Williamson and P. Mitacek IAEA report 1966. The results obtained were completed by determining the absorbed dose distribution for thin tissue samples as a function of the L.E.T. from calculations made using spectra and from proportional counter measurements. (FR)

18723 ENERGY DEPENDENCE OF THERMOLUMINESCENT DOSEMETERS FOR X-RAY DOSE AND DOSE DISTRIBUTION MEASUREMENTS IN A MOUSE PHANTOM. Puite, K. J.; Creboldor, D. L. J. M. (Instituut voor Toepassing van Atoomenergie in de Landboun, Wageningen, Netherlands). Phys. Med. Biol.; 19: No. 3, 341-347(May 1974).

Intercomparison studies of dose and distribution in animal radiobiology using TL dosimeters have indicated the need to determine the TL response per rad in muscle within an animal phantom. For this purpose a mouse-sized test phantom containing TL dosimeters was exposed to x-rays having a HVL value of 1.4 to 2.8 mm Cu. Dependence of the response of ^{7}LiF dosimeters on the HVL of the incident beam resulted in an increase of TL response per rad in muscle for dosimeters positioned at the central axis of the phantom compared with the response of similar dosimeters exposed free-in-air. An increase of 7 to 3% in TL response per rad in muscle was found over the HVL range. The spread in effective energy inside the phantom was small and the dose distribution may be estimated directly from the TL response of ^{7}LiF dosimeters at the entrance, central and exit position in the phantom. It was difficult to determine unique HVL values in a phantom using TL dosimeters. (auth)

18724 PORTABLE HAND HELD DOSIMETER. Ainsworth, G. C.; Schneider, M. F. (to Secretary of the Air Force, Washington, DC). US Patent 3,814,940. 4 Jun 1974. Filed date 25 Jun 1972. 6p.

A portable light weight hand held dosimeter for measuring both dose rate and total dose received is described. Dose rate is sensed then amplified by a logarithmic electrometer, the signal is processed through a differential amplifier and provides a reading on a calibrated voltmeter. Total dose is sensed and generates a voltage to charge a capacitor, which activates a field effect transistor network; the output is amplified in a compound transistor amplifier which drives a mechanical register. (Official Gazette)

18725 RADIATION DOSAGE MEASURING APPARATUS AND METHOD FOR THERMOLUMINESCENT DOSIMETERS. Jones, A. R.; Richter, W. F. (to Atomic Energy of Canada Ltd.). US Patent 3,823,323. 9 Jul 1974. Priority date 7 Jan 1972, Canada, 4p.

An automatic reading device for thermoluminescent dosimeters wherein the TLD is placed over a heated surface with a thermocouple placed between the side of the TLD away from the heated surface and the end of a light-pipe leading to a photo-multiplier tube or other light measuring device is described. In this arrangement only the heat that flows from the heater through the TLD to the thermocouple is measured and used for control purpose. (Official Gazette)

18726 STANDARD ARRANGEMENT OF THE CZECHOSLOVAK ACADEMY OF SCIENCES FOR THE REALIZATION AND ABSOLUTE MEASUREMENT OF EXPOSURES OF γ RADIATION. Klumpar, J.; Jirousek, P. (Laboratorium fuer Radiologische Dosimetrie, Prague). Isotopenpraxis; 10: No. 5, 184-189(May 1974). (In German).

The standard arrangement of the Laboratory for Radiological Dosimetry, Prague, for the exact realization and absolute measurement of exposures of γ-radiation, consisting of two ^{60}Co and one ^{137}Cs beam, and a free air pressure ionization chamber is described and the mean value of all measurements of the calibration constant executed between 1968 and 1973 is given. Some statements are derived from absorption measurements of the ^{60}Co beams concerning their spectral composition. Information on the protection against ionizing radiation is included. (auth)

18727 PREPARATION OF $CaSO_4$:Tm AND $CaSO_4$:Dy THERMOLUMINESCENCE DOSIMETERS, AND THEIR APPLICATIONS TO RADIATION MEASUREMENTS. Huang, C. Y. (Atomic Energy Council, Taipei, Taiwan); Tseng, C. L.; Chou, Y. Y. Nucl. Sci. J. (Taiwan); 9: No. 1-2, 12-21(Jun 1972).

The $CaSO_4$:Tm and $CaSO_4$:Dy thermoluminescence dosimeters have been prepared in the laboratory. The procedures and their properties are described. These self-made dosimeters have been used for environmental monitoring and low dose measurements. The possibilities of using the dosimeters for personnel monitoring and for thermal neutron detection are also included. (auth)

18728 METHODS OF MEASUREMENT OF PROFESSIONAL EXPOSURES TO EXTERNAL RADIATION SOURCES. Chysky, J. (Centrum Hygieny Zareni, Prague); Trousil, J. Radioisotopy; 15: No. 2, 301-306(1974). (In Czech).

Presently, more than 9000 persons are controlled in the CSSR with film dosemeters of the UVVVR laboratory which are evaluated after one month's exposure. Due to limited capacity, measurements cannot be performed for about 2000 persons. The measurement results are favorable; in the far greatest part of the monitored personnel, exposures lower than $1/10$ of the maximum permissible dose are found. This is evidence of a good standard of protection and is due also to the fact that workers are controlled even in workplaces with a very low radiation hazard. After evaluation of experiences, a more effective measurement technique responding better to the actual needs of the control is recommended. On working sites with a low probability of higher exposures, the film badge dosemeters are evaluated after two months exposure. Later on, after introduction of the thermoluminescent dosimetry, the control period will be extended over three months. On workplaces with a higher probability of high exposures, the personal dosemeters will still be evaluated after one month. In addition, thermoluminescent dosemeters will be mounted in the film badges, enabling even the reading of high accident exposures. The extension of the control of several thousand persons will relieve a part of the capacity of the film dosimetry laboratory. This

capacity will be used for the establishment of personal exposure control on hitherto uncontrolled working sites. (auth)

18729 USE OF THERMOLUMINESCENT DOSEMETERS IN THE DOSIMETRY OF MIXED RADIATION FIELDS. Hermanska, J. (Katedra Dozimetrie a Aplikace Ionizujiciho Zareni, Prague); Rakovic, M.; Prouza, Z. Radioisotopy; 15: No. 1, 99-133(1974). (In Czech).

Some newer methods of the use of thermoluminescent dosemeters in the dosimetry of mixed radiation fields are discussed with emphasis on the neutron–gamma fields. Namely the application possibilities in radiation hygiene and in radiobiological, radiotherapeutical and radiodiagnostic dosimetry are treated. The authors present their results, obtained in the development of a dosimetric system for radiobiologists concerned with irradiation of small laboratory animals with thermal neutrons in a nuclear reactor. (auth)

18730 THERMOLUMINESCENT DOSIMETRY AS A PART OF DOSIMETRIC SYSTEM FOR RADIOBIOLOGICAL EXPERIMENTS WITH THERMAL NEUTRONS. Hermanska, J. (Dept. of Dosimetry and Application of Ionizing Radiation, Prague); Novotny, J.; Prouza, Z.; Rakovic, M. Jad. Energ.; 20: No. 5, 161-164(May 1974). (In Czech).

The work considers possibilities of estimating the gamma ray dose in the course of irradiating small laboratory animals in a mixed radiation field of thermal neutrons and gamma rays at a nuclear reactor. The thermoluminescent dosimeters (LiF, ^{7}LiF) represent a part of a dosimetric system for radiobiological experiments. Results of calibrating thermoluminescent dosimeters for the used types of radiation and calculations of doses during irradiation of experimental objects are presented. (auth)

18731 PRINCIPLES OF RADIATION DOSIMETRY. Whyte, G. N. Prague; Academia–Publishing House of the Czechoslovak Academy of Sciences (1973). 113p. (In Czech).

Basic properties are outlined of the radiation field, beams, interaction of ionizing radiation with matter, methods of determining the spectra and the x radiation intensity, and the exposure and absorbed doses. The principles of dosimetry of charged particles and neutrons are presented. A brief description is given of several types of secondary radiation detectors and of the methods of their calibration. (Nuclear Sci. Abstr. Czech.)

18732 CORRECT HANDLING OF THERMOLUMINESCENT LiF:TEFLON DOSIMETERS. Blackman, T. E.; Johns, T. F.; Preston, H. E.; Mason, E. W.; Marshall, T. O.; Shaw, K. B. (Atomic Energy Establishment, Winfrith, Eng.). Brit. J. Radiol.; 47: No. 558, 361-363(Jun 1974).

Brief criticism is made of a previous paper (Hasman, A. and Groothedde, R. T., Br. J. Radiol., 46, p637-640 (1973)), describing difficulties encountered with the use of LiF:Teflon dosemeters. It is pointed out that changes in sensitivity due to storage can be avoided by pre-irradiation at 80°C for 20 hr or 100°C for 2 hr. It is observed that there is variation in workers' results with regard to discoloration. This is discussed in relation to the authors results of cycling a batch of LiF:Teflon discs 20 times. The discs were held for 10 sec at 280°C during the read cycle, and a pre-irradiation anneal at 100°C for 2 hr was given. Discoloration was small and no significant change in sensitivity occurred. Cleaning is also mentioned in relation to ultrasonic cleaning and the use of organic solvents. (UK)

18733 ASSISTED RADIATION RECOGNITION FOR PHOTOGRAPHIC DOSIMETER DATA. Bermann, F.; Chanourdie, J. C. (CEN, Fontenay-aux-Roses, France). Radioprotection; 8: No. 3, 189-205(1973). (In French).

The interpretation of the data available on the response of a multiscreen photographic dosimeter has been subjected to different processing methods which are reviewed. A new one is presented which uses linear programming. This method, through a high degree of flexibility, can take account of any peculiarity of the dose or energy response of the emulsion. By this way, it may happen that one can take advantage of what was considered as a drawback to this particular type of dosimeter. (FR)

18734 USE OF PHOTOLUMINESCENT FOR THE MEASUREMENT OF IONIZING RADIATION EXPOSURES. Kodl, O. (Inst. of Hygiene and Epidemiology, Prague); Trousil, J. Radioisotopy; 15: No. 1, 147-154(1974). (In Czech).

The dosimetric properties of the photoluminescent glasses Toshiba type FD 3 as measured in the apparatus Toshiba FGD-6 are described. Based on the study of the effect exerted by the cleaning of the glasses before measurement, a method was developed which guarantees a good reproducibility of luminescent response measurement. Further, the effect of the build-up of the luminescent response with time after irradiation and the fading and the response linearity within the exposure range from 50 mR to 1000 R were studied. The energy dependence of the glasses was determined for the range between 15 keV and 1.25 MeV, both for the glasses alone and for dosimetric badges with a copper compensation filter. The results were statistically processed and the total error of the measurement of ionizing radiation exposures is determined. (auth)

18735 THERMOLUMINESCENT DOSIMETRY IN THE RADIOLOGICAL SCIENCES. Raeside, D. E.; Anderson, D. W. (Univ. of Oklahoma, Oklahoma City). Radiol. Technol.; 46: No. 1, 20-26(1974).

An elementary introduction to the applications of thermoluminescence in the radiological sciences is presented. (auth)

18736 PERSONNEL AND ENVIRONMENTAL THERMOLUMINESCENT DOSIMETRY FOR A UNIVERSITY REACTOR LOCATED IN A SEMITROPICAL AREA. Weng, P. S. (National Tsing Hua Univ., Hsinchu, Taiwan); Huan, C. Y. Radiat. Data Rep.; 15: No. 5, 247-252(May 1974).

The ^{7}LiF-Teflon discs were added to the film badges for personnel monitoring during a 6-month period. The results showed a consistently higher dose in the thermoluminescent dosimeter than in the photographic film dosimeter, which might exhibit about 90% fading during the 4-week period in a hot and humid climate. In winter time, it was found that the response from both LiF-Teflon disc and film showed more consistent results due to better climate conditions in Taiwan. The $CaSO_4$:Dy and $CaSO_4$:Tm phosphor powders and LiF:Mg, Ti, enclosed in a knot of bamboo stick, were used for environmental monitoring at a university reactor site and inside a research reactor building. The results showed that they were unaffected by extremes of humidity and environmental temperatures in area monitoring, either indoors or outdoors. (auth)

18737 SPRAVOCHNIK PO DOZIMETRII I RADIATSIONNOI GIGIENE. (Reference Book on Dosimetry and Radiation Health Physics). Moiseev, A. A.; Ivanov, V. I. Moscow; Atomizdat (1974). 336p.

Tabulated data, formulas, and relations used in the evaluation of the level of radioactive contamination of the environment and in the calculation of the dose of external and internal irradiation of different organs and tissues of the human body are given. Methods for the statistical processing of measurements most often found in practice are examined. Data on permissible levels of irradiation and the clinical effects of irradiation at different doses are given. The provisions of the Standards of Radiation Safety (NRB-69) and the Basic Principles of Work with Radioactive Materials and Other Sources of Ionizing Radiation (OSP-72) are reported. (tr-auth)

18738 RECENT TRENDS IN THE DEVELOPMENT OF APPLICATIONS OF EXOELECTRON EMISSION. Lausch, W. (Technische Univ., Dresden). Kernenergie; 17: No. 5, 129-136(1974). (In German).

The fundamentals of the mathematical treatment and measuring methods of exoelectron emission are discussed. Various potential applications of the thermally-and optically-stimulated effect are described. (auth)

18739 DOSIMETRY OF IONIZING RADIATIONS USING GLASS COLORANT DETECTORS. Tkachenko, V. V.; Briskman, B. A.; Kovalenko, L. M.; Lavrentovich, Ya. I.; Orlov, N. F. Sov. At. Energy (Engl. Transl.); 35: No. 3, 860-861(Sep 1973).

Translated from At. Energ. (USSR); 35: No. 3, 210-211(Sep 1973).

Properties of aluminophosphate glasses doped with manganese for dosimetry are discussed. The variation of optical density of irradiated glasses with absorbed dose for gamma radiation, protons, deuterons, and alpha particles is shown graphically. The possibility of using these glasses for gamma dosimetry in mixed gamma–neutron fields is discussed. (WHK)

18740 GAMMA-RAY RESPONSE OF PARAROSANILINE CYANIDE DOSIMETER SOLUTIONS. McLaughlin, W. L. (National Bureau of Standards, Washington, DC); Kosanic, M. Int. J. Appl. Radiat. Isotop.; 25: No. 6, 249-262(Jun 1974).

Triphenylmethane dye derivatives, especially the colorless nitriles in organic or aqueous solution, serve as convenient radiation dosimeters. With large absorbed doses (10^3 to 10^6 rads), permanent ionized dye is produced with sufficient color for routine photometric measurement. If a polar solvent is used and the solution is oxygenated and stabilized by weak acid, the optical density measured at the absorption maximum of dye is

a linear function of dose. Dye yield varies with the type of solvent, concentration of the dye precursor, temperature during irradiation, acid and oxygen content and batch of dye precursor used. Additions of small amounts of acid to solutions prevent back reactions. Dissolved oxygen or a weak oxidizing agent helps extend the dose range of response by scavenging free-radical agents formed in the solvent during irradiation. Suitable plastic containers may be used, without the need for ultraclean handling procedures or superdistilled solvents. Since the main sources of systematic error are easily controlled and since the new dosimeter solutions may be used over a wide dose range, they show advantages over other chemical dosimeters for many applications. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 18806, 18807, and 20231.

18741 (JAERI-M-5643) FAST NEUTRON SPECTRUM MEASUREMENT WITH THE THRESHOLD DETECTORS. Tanaka, S.; Kutsukake, C. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 33p. (In Japanese). NTIS (US Sales Only).

A method for obtaining the fast neutron spectrum with a threshold detector is described, including criteria for choosing threshold detectors and the properties (half life, branching ratio, gamma-ray spectrum, threshold reaction cross section, etc.). The relative deviation minimization method and iterative method for unfolding are also explained. To evaluate the validity, the fast neutron spectrum in an irradiation hole of the JRR-4 reactor was obtained with the threshold detectors; and the experimental error, cross sections, and conditions for unfolding were examined. The results obtained are compared with those by the one-dimensional S_n code ANISN in an attempt to reveal the propriety of fast neutron spectrum measurement with the threshold detectors and the problems involved. (auth)

18742 (JINR-10-7034) MULTIPARAMETER MEASUREMENTS BASED ON THE MINSK-2 COMPUTER IN NUCLEAR SPECTROSCOPY. Vylov, Ts.; Zaidler, Z.; Zvol'ski, J.; Kondrat, E. T.; Kuznetsov, V. V.; Morosov, V. A.; Fominykhm, M. I.; Fominykh, V. I.; Tsupko-Sitnikov, V. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 19p. (In Russian). INIS.

Apparatus was designed on the basis of the Minsk-2 computer for carrying out multiple measurements of gamma-gamma spectrum coincidences, the life of the activated nucleus, the angular gamma-gamma correlation, etc. The radiation was recorded using Ge–Li and NaI(Tl) detectors. Computer memory use was optimized by selection of available information, using numerical window methods. Rational organization of measurements was examined. The information was processed on the Minsk-2 computer by special programs using an oscillograph with a light pencil. (tr-auth)

18743 (JINR-10-7130) ORGANIZING OF MATHEMATICAL ENSURING OF PRELIMINARY DATA PROCESSING OF SPECTROMETRY INFORMATION BY MINSK-32 COMPUTER. Zlokazov, V. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1973. 8p. (In Russian). INIS.

The organization of the mathematical provisions for processing spectrometer data on the Minsk-32 computer is described. These provisions consist of a special library of programs for processing and for interaction of the computer and user, which simplifies the interaction. The language used is described. (tr-auth)

18744 (KHFTI-72-8, pp 172-173) MULTI-CHANNEL COUNTER FOR THE SPECTROMETER EXPERIMENT AUTOMATIZATION. Danilenko, A. D.; Ryabka, V. V.; Yamnitskii, V. A. 1971. (In Russian).

The characteristics of a multichannel counter, representing a device for the accumulation of data, accessible in the form of pulses of standard amplitude (12 V) and a duration of 1.2 μ sec from several independent channels (up to a 100), are described. Included in the device are receiving registers, control devices, magnetic operational storage devices, two address registers, perforator, electron beam tube with analog-digital converter, and a desk for the operator of the power pack. The total volume of the magnetic operational memory device is 512 elements. The principal circuits of the device are constructed on the standard units of the Dnepr computer. The counter was designed for operation without connection to a computer and within the experimental apparatus are duplicating elements which can be used during output from the computer system which does not interrupt the course of the experiment. (tr-auth)

18745 (ORNL-TM-4603) THEORETICAL COMPARISON OF SINGLY-MULTIPLEXED HADAMARD TRANSFORM SPECTROMETERS TO SCANNING SPECTROMETERS. Larson, N. M.; Crosmun, R.; Talmi, Y. (Oak Ridge National Lab., Tenn. (USA)). Jul 1974. Contract W-7405-eng-26. 36p. Dep. NTIS $5.00.

A general mathematical framework within which the relative performance of singly-multiplexed Hadamard Transform Spectrometers (HTS) and conventional scanning spectrometers (SS) may be compared is presented. The theoretical multiplex advantage (Fellgett advantage) is calculated for spectrometers operating in two spectral regions. For the low energy region, i.e. infrared, the determined multiplex advantage F is $\sqrt{N/2}$ (N is the number of slots), in accordance with predictions given by Fellgett. For the high spectral energy region, i.e. UV–VIS, $F = (x/2\bar{x})^{1/2}$ where x is the intensity of the spectral element sought and $\bar{x}$ is the average intensity produced across the whole spectrum. Predictions are verified by computer simulation of various characteristic spectra. Based on these results some conclusions concerning the practical application of HTS systems are presented. (auth)

18746 MOESSBAUER SPECTROSCOPY. Cranshaw, T. E. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., E (London); 7: No. 7, 497-505(Jul 1974).

A brief account of the Moessbauer effect and its applications is given. The most popular types of spectrometer are described and their deficiencies considered in some detail. The problems of the reduction of data and the problems of obtaining spectra at low temperatures are discussed. A final section considers the choice of counters for transmission and backscattering methods. (auth)

18747 DATA ACQUISITION AND REDUCTION OF HIGH RESOLUTION GAMMA-RAY SPECTRA. Cottrell, D. B. Gainesville, FL; Univ. of Florida (1973). 321p. University Microfilms Order No. 4-9591.

Thesis (Ph. D.).

A versatile, mini-computer based laboratory system was developed for the collection and reduction of high resolution gamma spectra. A dedicated mini-computer served as both a control and memory for the data acquisition, and a central processing unit for the automated data reduction. An interface and timing system were designed and constructed to allow computer control of the data acquisition. A complete software package was written to perform all aspects of the data acquisition and reduction. The application of the total analytical system to the analysis of a complex biological material was studied. A new peak detection algorithm, sensitive to small signal-to-noise peaks, was developed to automatically search the digital data and determine the locations and boundaries of photo-peaks in a gamma-ray spectra. A technique was devised to perform curve fitting by the method of nonlinear least squares on a mini-computer. A new function, which defines the shape of a photopeak in a Ge(Li) spectrum, was developed and tested. Photopeak areas calculated from the fitted functions were compared to the peak areas determined by conventional methods directly from the digital data. (Diss. Abstr. Int., B)

18748 AN OPTIMIZATION PRINCIPLE FOR FILTERS USED IN NUCLEAR SPECTROSCOPY WITH SEMICONDUCTOR DETECTORS AT HIGH PULSE RATES. Schuster, H. J.; Weise, K. PTB Mitt.; 83: No. 6, 389-394(Dec 1973). (In German).

10 figs.; 14 refs.

An optimization principle of maximum energy resolution is described for filters used in nuclear spectroscopy at high pulse rates. It is superior to that of greatest signal-to-noise ratio for the energy determination of spectral lines and is especially applicable in case of using a pile-up rejector. The optimum parameters of an RC-RC-filter, an active filter and a time-variant filter are calculated by this principle as a function of the noise, the spectrum to be measured, and the pulse rate. (GE)

18749 GAIN CONTROL OF CHARGE-SENSITIVE PREAMPLIFIERS FOR USE IN SPECTRUM STABILIZATION. Kosina, Z. (Inst. of Nuclear Physics, Rez, Czech.). Jad. Energ.; 20: No. 3, 91(Mar 1974). (In Czech).

The circuit diagram of a variable-gain charge-sensitive preamplifier for stabilization of high resolution nuclear spectrometers is given. (WHK)

18750 HIGH RESOLUTION α SPECTROMETRY. Lueck, H. B. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden). Nature (London); 249: No. 5459, 750-751(21 Jun 1974).

It is stated that deficiencies in energy resolution have been an obstacle to the widespread application of dielectric track detectors, and the best resolution so far obtained covered a span of only 150 to 200 keV. A procedure is described, however, that makes use of the range differences obtained with α particles of diverse emission energies, and that provides substantially improved energy resolu-

tion. Very sensitive cellulose nitrate sheets are employed in the detector. To demonstrate the high degree of energy resolution, a 38 μm detector sheet was irradiated with ^{210}Po α-particles and with a ThC source, with a distance of 50 mm. between source and detector. KOH was used for etching. (UK)

18751 CHARGED PARTICLE SPECTROGRAPH OF SEMICONDUCTOR DETECTOR WITH A SMALL MAGNETIC ANALYZER. Yang, C. K.; Li, W. C.; Kuo, C. C.; Chu, K. H.; Chiang, C. L. Wu Li Hsueh Pao; 23: No. 1, 52-62(24 Jan 1974). (In Chinese).

A new type of charged particle spectrograph has been developed which combines the property of a small magnet which can analyze the particle momentum with the property of a semiconductor which has a higher energy resolution. As a result, the particle identification and the analysis of the energy spectrum can be obtained simultaneously. The design and structure of this spectrograph are described; some experimental results of using it in nuclear reaction studies are given; and its applications and characteristics are discussed. This kind of spectrograph is simple and easy to use, and gives good performance. (JPRS)

High Energy Physics Instrumentation

Refer also to abstracts 19490 and 19505.

18752 (AED-Conf-74-044-004) BEAM BENDING MAGNETS IN AN ENERGY-LOSS SPECTROMETER FOR THE ANALYSIS OF HIGH-ENERGY ELECTRONS. Glueckert, S. 1974. 9p. (In German). INIS.

From exhibition and experts meeting "Nuclear Technology"; Frankfurt am Main, F. R. Germany (18 Mar 1974).

8 figs.

Following a brief introduction into the main features of elastic and inelastic electron scattering, subsequent analysis of scattering angle and energy, and the basic characteristics of dipole and quadrupole magnets for beam bending as well as a rough description of the equipment used in the experiments, the model of a new "energy-loss measuring arrangement" is described that has been developed to achieve higher intensities and better resolution. The beam bending system consisting of three dipole magnets and its technical data and characteristic trajectories is discussed in detail. From theoretical calculations, a resolving power better than 5×10^{-4} is expected. (GE)

18753 (CONF-730804-P2, pp 857-862) PRESENT STATUS OF THE COUPLING FUNCTIONS FOR THE UNDERGROUND MUON TELESCOPES. Ahluwalia, H. S. (Univ. of New Mexico, Albuquerque). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The coupling functions presently available for the muon telescopes located underground are updated. A new normalization procedure is proposed for an easier practical use of the coupling function proposed by Ahluwalia and Ericksen (1971). This procedure leads to a revision upwards of the median primary rigidity of response (R_m) of a muon telescope underground. For a telescope at 60 mwe depth, R_m = 137 GV. It is suggested that the coupling functions derived from Monte Carlo calculations of meson production in the atmosphere lead to a large excess in the number of muons produced, by high energy primary nucleons. (auth)

18754 (JINR-1-7153) SOME METHODIC PROBLEMS IN PROCESSING FILMS FROM THE JINR 100 cm HYDROGEN BUBBLE CHAMBER. Val'ter, M.; Glagolev, V. V.; Konstantinesku, A.; Lebedev, R. M.; Saitov, I. S.; Strel'tsov, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 15p. (In Russian). INIS.

The results of the precision of measurements of points in the space of the photographing of a 100-cm hydrogen chamber at JINR are presented. The space-resolving capability with measurements on semiautomatic microscopes was 80 μ. The resolution of the chamber relative to the resonance widths in the experiments with negative pions with 5-GeV/sec pulses was determined. (tr-auth)

18755 (JINR-10-6837) EVENT SETTING UP PROGRAM FOR COMPUTER CDC-1604A. Vladimirov, L. A.; Durnovo; I. M.; Shvachka, A. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1972. 8p. (In Russian). INIS.

The SMOG program, designed for assembling segments of tracks from bubble chambers, miscalculated by the HAZE2 program, to one event is described. The format of the SMOG output magnetic tape should conform with the THRESH input, accomplishing a geometric reconstruction of the events. Machine time used in processing one event in the presence of two measured projections averages about 1.5 sec. (tr-auth)

18756 (JINR-10-7191) GEOMETRIC PROGRAM FOR THE LIQUID HYDROGEN BUBBLE CHAMBERS FOR THE BESM-6 COMPUTER. Buzdavina, N. A.; Ivanov, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1973. 16p. (In Russian). INIS.

A geometrical computer (BESM-61) program for the JINR liquid hydrogen chambers is discussed. The program is designed for reconstruction of the events, the recordings of which are measured both semi-automatically and by automatic systems. (tr-auth)

18757 (JINR-13-7014) DEVELOPMENT OF THE PROPORTIONAL CHAMBERS IN THE LABORATORY OF HIGH ENERGIES. Zanevskii, Yu. V.; Kuryatnikov, B. K.; Novikov, E. A.; Peshekhonom, V. D.; Pugachevich, V. P.; Ural'skii, D. V. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1973. 14p. (In Russian). INIS.

Proportional chambers developed and constructed at the JINR High Energy Laboratory are described. The method for preparing the chambers for work in experimental equipment is presented. (tr-auth)

18758 (KHFTI-72-8, pp 3-13) WAYS TO REDUCE THE MACHINE TIME OF COUNTING WHILE PROCESSING CHAMBER FILMS. Vatset, P. I.; Koltunov, I. A.; Lyubarskii, G. Ya. 1971. (In Russian).

Questions on the determination of the kinematic parameters of particles applicable to chambers having more than two objectives are examined. Basically the efforts were devoted to reduction of the machine processing time under a definite level of error of the experimental method. The method developed used the smallness of the parameters characterizing the difference of the existing chambers from the "ideal". Questions such as exclusion of points, poorly measured on the semiautomatic measurement devices, calculation of the movement of the charged particle in a non-homogeneous magnetic field with consideration of the ionization loss, and card design with consideration of the non-ideality of the optics are also examined. Tests of the proposed processing program showed that the processing time for three-track events in the presence of three cards is 100 sec during the measurment of 10 points on each card and 90 sec during the measurement of 7 points. An evaluation was made of the precision obtained. (tr-auth)

18759 (KHFTI-72-8, pp 13-17) GENERAL DESCRIPTION OF THE PROGRAM FOR THE GEOMETRY RECONSTRUCTION OF THE BUBBLE CHAMBER FILM PROCESSING. Adushkina, R. I. 1971. (In Russian).

A general description is given of the geometric reconstruction program used for the processing of films obtained with the liquid hydrogen bubble chamber. The program is based on the use of the M-220 computer. As a result of the operation of the program the coordinates of the points of separation and the parameters of particles emitted in the reaction can be found. Data for processing is first stored on magnetic tape by means of a special program. The basic parts of the algorithm of geometric reconstruction are realized in the forms of standard programs of $10,000_8$ words. All standard programs combine non-standard controlling programs of 4000_8 words. The programs were used on a great number of simulated events. As a result of these tests deficiencies in the operation of the program were established, the optimum working regime was found, and recommendations were made for measurement of the stereoframe. (tr-auth)

18760 (KHFTI-72-8, pp 18-22) CALCULATION OF THE COEFFICIENT OF TRANSITION FROM ONE COORDINATE SYSTEM INTO ANOTHER ONE ON THE BASIS OF EXPERIMENT DATA. Zinov'eva, O. G. 1971. (In Russian).

A method is described for the calculation of the coefficient of transition from one coordinate system to another on the basis of experimental data from studies of nuclear reactions occurring in bubble chambers, diffusion chambers, and other chambers. Algorithms of the program for the calculation of the shrinkage coefficients of the films and certification of the program for the calculation of the shrinkage coefficients are reported. A description is given of the results of the certification. (tr-auth)

18761 (KHFTI-72-8, pp 34-40) PROGRAM FOR CALCULATING PARAMETERS OF OPTICAL SYSTEMS OF SMALL CHAMBERS WITH SEVERAL OBJECTIVES. Vaisfel'd, A. M.; Koltunov, I. A. 1971. (In Russian).

The question of the determination of some constants of the optical system of small chambers with several objectives, necessary for detecting relations between the coordinates of

a point of a track in the measured and spatial coordinate system, is examined. The layout of the problem and its solution algorithm are given. The results of the refinement of the parameters of the optical system of the bubble chamber by simulation of test objects are reported. This procedure for the refinement of the parameters was developed in the form of a standard program written for the M220A. (tr-auth)

18762 (KHFTI-72-8, pp 47-49) OPTIMUM ADJUSTMENT OF ACCURACY OF THE PAD-2 SEMIAUTOMATIC DECODER. Yamnitskii, V. A. 1971. (In Russian).

The optimum adjustment of the accuracy of the semiautomatic decoder PAD-2, used for measurement of the photofilms from the spark chamber of the Physics-Technical Institute, was examined. The characteristics are described and the parameters of the decoders were given. (tr-auth)

18763 (KHFTI-72-8, pp 109-114) INFORMATION CHARACTERISTICS OF DEVICES FOR TRACK MEASUREMENTS. Kuz'michev, M. A. 1971. (In Russian).

The application of the information theory to the solution of problems of design of measurement devices was tested. Photographs obtained during measurement of particle tracks in bubble, spark, and other chambers were the original source of information. The measurement process was represented in the form of communication channels. A coder converting information for transmission along the communication channels were the measurement devices. The receiver decodes the information, which role is filled as a rule by a computer. The information capacity of the photodocuments was isolated and an evaluation is given of the relative loss of information. (tr-auth)

18764 (KHFTI-72-8, pp 135-138) SEMIAUTOMATIC SCANNING TABLE. Zeidlits, P. M.; Kuz'michev, M. A.; Lichman, V. I.; Yamnitskii, V. A. 1971. (In Russian).

The construction and basic technical characteristics of a semiautomatic scanning table designed for measurement of photographs from spark and bubble chambers, oscillograms recorded on photographic film, and diagrams of self-starting instruments and any graphs whose dimensions do not exceed 500 × 500 mm, are described. The results of the scanning table since 1969 in the processing of experimental data of plasma-beam interactions obtained in the form of oscillograms are reported. (tr-auth)

18765 (KHFTI-72-8, pp 148-149) SEMIAUTOMATIC MEASURING DEVICE ELECTRONICS. Alymova, N. V.; Vorob'eva, V. P.; Zakirova, I. L.; Lebedev, P. M.; Lysenko, A. A.; Yamnitskii, V. A. 1971. (In Russian).

A semiautomatic installation for measurement of photographs for the determination of the coordinates of tracks of nuclear particles from photographs obtained in bubble, diffusion, and spark chambers and for the measurement of any flat object (oscillogram for example) is described. This installation consists of an electronic bay and measurement instruments such as the PUOS measurement microscope (in number 4-x pieces) or the PAD-2 semiautomatic decoder (in number 2-x pieces). Data with the semiautomatic installation were introduced by programs in the Dnepr-21 computer. The construction of the electronic bay was carried out on the basis of potential logic elements of the MIR-1 type. (tr-auth)

18766 (RL-74-38, pp Paper 4) COMPUTING TECHNIQUES FOR A SPARK CHAMBER EXPERIMENT. Wickens, F. (Birmingham Univ., Eng.). 1973.

From school for young high energy physicists; Chilton, UK (15 Jul 1973).

The aim of this course is to give an introduction to the computing techniques used in the design and analysis of a typical high energy physics experiment using spark chambers and counters. Some of the techniques described are of far wider applicability than just to high energy physics (e.g. least squares fitting and Monte-Carlo methods). Others such as histogramming techniques are also used by bubble chamber physicists. The subject is discussed under the following headings: basic tools (least squares fitting, Monte Carlo techniques, analysis of a magnetic field, particle tracking, histogramming); the design of the apparatus; perform the experiment; the analysis of the experiment (spark reconstruction, track finding, momentum fitting, vertex determination); acceptance calculations; study of systematic effects; calculation of the final results; fitting Legendre polynomials to the results. (UK)

18767 THRESHOLD GAS CHERENKOV COUNTER. Kajiwara, M.; Kuge, A.; Okudaira, K. (Rikkyo Univ., Tokyo). Uchusen Kenkyu; 17: No. 4, 540-544(Feb 1973). (In Japanese).

From symposium on charged particles and cosmic radiation; Hamanatsu, Japan (Dec 1971).

It was decided to use the increase of ionizing loss in gas based on the theory of relativity to measure high energy components (GeV to TeV) of primarily charged cosmic ray. Since the elimination of low energy components is important for the measurement in this region, a threshold gas Cherenkov counter was employed. Although the gas Cherenkov counter detects Cherenkov light emission, gas pressure must be from several to tens of kg/cm^2, because the refractive index of gas is small. Large volume is also required to increase the number of photons. Efficiency of the counter produced was examined by measuring sea-level muons. Since the mean number of electrons Ne emitted from a photoelectric surface is a function of muon energy, the threshold efficiency ϵ was 0.92 from the derivative spectrum of muons if critical kinetic energy E_T was equal to 1 GeV. The measurement of energy spectra between 200 MeV/n and 200 GeV/n at $Z \geq 10$ is expected by using the multi-stage Cherenkov counter together with a scintillation counter. (JA)

18768 DEVELOPMENT OF HIGH ENERGY DETECTORS. Tu, Y. T. Wu-li; 3: No. 1, 34-40(18 Feb 1974). (In Chinese).

Various high-energy detecting devices such as cloud chambers, G-M counters, Cherenkov counters, scintillation counters, gas bubble chambers, spark chambers, liquid xenon direct proportional chambers, filament spark chambers, and drift chambers are described. All detectors are required to have 100% recording efficiency, high space resolving power (less than several microns to 2 mm), and short dead time (less than 10^{-9} sec to 1 sec). The high-energy detecting devices at CERN and the cosmic ray detector at Uzbek are discussed. The development of nuclear accelerators toward the 1,000 GeV level are foreseen, while the high-energy particle detectors still remain at the 1 GeV stage. The solution may lie in the improvement of the time and space resolving power of the existing detectors, in increasing their magnetic intensity, and in using holographic tracing chambers. (JPRS)

Radiometric Instruments

Refer also to abstract 18837.

18769 (ANCR-1160) DYNAMIC GAMMA ATTENUATION DENSITY MEASUREMENTS. Piper, T. C. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). May 1974. Contract AT(10-1)-1375. 20p. Dep. NTIS $4.00.

The considerations important in making density measurements, in small response time, by gamma attenuation measurement are enumerated and commented upon. A formula for the gamma source strength versus various parameters is obtained. Errors due to filtering, "streaming," wall adherence, and detector peculiarities are discussed. (auth)

18770 REPORT OF THE X-RAY THICKNESS GAUGE SUB-COMMITTEE. Suzui, H. (Nippon Steel Corp., Tokyo). Tetsu To Hagane; 59: No. 14, 2011-2017(Dec 1973). (In Japanese).

Discussions by the X-ray thickness gauge sub-committee set up in the instrumentation committee of the Joint Study Project in Japan Iron and Steel Association are outlined. Examining the state of installation of thickness gauges in eleven factories of six companies participating in the sub-committee, radiation thickness gauges have increased since 1968. X-ray thickness gauges give rise to errors due to the temperature change of steel, water film on steel, pile up of scales on x-ray tanks and other effects. Methods for correcting for these errors are discussed. "Recommended Practice of Standard Testpieces for X-ray Thickness Gauges" has been compiled to operate the gauges accurately. As a future problem, the development of thickness gauges of better response (within 10 m/sec) and lower cost is desirable. (JA)

18771 COATING THICKNESS MEASUREMENTS ON SHEET METALS FOR CANS WITH THE β-BACKSCATTER METHOD. II. Andrae, W.; Krautkramer, P. Verpackung (Leipzig); 12: No. 4, 133-136(1971).

Details are given of tests using the β-backscatter method to measure the coating thickness on tin cans. Suitable β-radiating systems, test equipment and arrangement of test apparatus are discussed. The results of the tests are reported. (Corros. Abstr.)

18772 RADIOMETRIC METHOD OF MEASURING THICKNESSES ON THE CHROMIUM COATINGS. Sekowski, S. (Instytut Mechaniki Precyzyjnej, Warsaw). Nukleonika; 19: No. 4, 365-379(1974). (In Polish).

The rapid growth of applications of non-destructive methods of measuring decorative and protective coats, observed recently, did not include determining thicknesses of chromium coats. Presently, in our country, thicknesses of those coats are not measured at all, or, their determination is made by not quite accurate destructive methods, such as the drop method (error ± 20%), or the

complete dissolving method (error ± 15%). In the years 1969–1971 the Institute of Precision Mechanics and the Central Laboratory of Printing Industry started elaboration of a non-destructive method for measuring thicknesses of chromium coats. Such measurements are particularly important in the printing industry, using two- and three-metal plates for offset printing. They are steel or zinc plates which are coated with copper then with chromium, or copper cylinders coated with chromium. (auth)

18773 FAST INDICATOR OF BETA RADIATION WITH INTEGRAL IONIZATION CHAMBER. Pucek, B. (State Textile Research Inst., Liberec, Czech.). Jad. Energ.; 20: No. 4, 124-127(Apr 1974). (In Czech).

An analysis of dimensions for an ionization chamber for the application of an operational amplifier) in relation to the time constant of the indicator is presented. Indicators made for textile slivers, with a time constant of 0.01 s are described. Also, the output signal is used for the analysis and identification of sources of defects on production lines. (auth)

18774 ATMOSPHERIC PARTICULATE MASS MONITORING WITH A β RADIATION DETECTOR. Husar, R. B. (California Inst. of Tech., Pasadena). Atmos. Environ.; 8: No. 2, 183-188 (Feb 1974).

From 13th conference on methods in air pollution and industrial hygiene studies; Berkeley, CA (30 Oct 1972).

The use of a commercial β radiation detector for semi-continuous atmospheric particulate matter monitoring was investigated. Gravimetric calibration using sodium chloride, cigarette smoke and atmospheric aerosols indicated a consistent linear relationship between aerosol mass concentration and β radiation attenuation. The precision of detection is ±10 μg which at an ambient particulate concentration of 100 $\mu g\ m^{-3}$ permits the mass concentration measurement every h. The aerosol stability on the filter and the effect of r.h. on deposited samples of sodium chloride was studied. (auth)

18775 RADIATION GAUGE TO MEASURE THE THICKNESS OF VERY THIN FILMS. II. Yamashita, T.; Momoi, T. (Kumamoto Univ., Japan). Kumamoto Daigaku Kogakubu Kenkyu Hokoku; No. 22, 1-3(Sep 1973). (In Japanese).

A β-ray backscatter thickness gage capable of measuring films of about 100 Å is described. Film thickness of 1000 Å is measured with accuracy of ±15 Å. (TFD)

18776 A METHOD FOR THE MEASUREMENT BY NEUTRONS OF THE THICKNESS OF PLASTIC LININGS OF CHEMICAL APPARATUS. Selecki, A. (Politechnika Warszawska (Poland). Inst. of Chemical Engineering). Kerntechnik; 16: No. 4, 158-162 (Apr 1974). (In German, English).

8 figs.; 2 tabs.; 4 refs.

It is shown how the incident back-scattered neutron radiation can be used for the contactless measurement of the thickness of interior plastic linings of chemical apparatus and containers. The fraction of neutron radiation back-scattered by a double layer wall is composed of two components, one with a high energy and one with a partially thermalized energy with an intensity dependent on the thickness of the lining. (GE)

18777 METHODS FOR THERMAL NEUTRON DIFFUSION COEFFICIENT LOGGING. Smith, M. P. (to Texaco Inc.). US Patent 3,818,225. 18 Jun 1974. Filed date 18 Sep 1972. 10p.

An illustrative embodiment of the present invention includes methods for thermal neutron diffusion coefficient logging. Two spaced thermal neutron detectors are deployed at different distances from a pulsed source of 14 MeV neutrons. Each detector samples the thermal neutron population over two different time intervals following the emission of a burst of neutrons by the source. Count signals from the detectors are combined according to predetermined relationships to derive signals representative of the thermal neutron diffusion coefficient, the initial neutron age, the porosity and the water saturation of the earth formations in the vicinity of the borehole. (Official Gazette)

18778 POROSITY DETERMINATION WITH MUDCAKE CORRECTION. Tittman, J. (to Schlumberger Tech. Corp.). US Patent 3,823,319. 9 Jul 1974. Filed Date 23 Mar 1973. 8p.

An illustrative embodiment of the invention provides an accurate mudcake correction for sidewall neutron borehole logging tools. A sidewall porosity sonde is equipped with a vertically separated neutron source and a neutron detector that are both centered in the tool in order to engage one side of the borehole wall. This basic porosity measuring array is supplemented by a source of lower energy neutrons having appreciably shorter slowing down length and another detector, for appropriately sensing the influence of the mudcake. A circuit combines signals from the detectors to produce an indication of the formation porosity. (Official Gazette)

18779 CONTAINER FILL LEVEL INSPECTOR WITH PRODUCT AVERAGING SYSTEM. Kirkpatrick, F. J. (to Nuclearay Inc.). US Patent 3,818,232. 18 Jun 1974. Filed Date 13 Dec 1972. 18p.

A method and apparatus for continuous monitoring of containers being conveyed from an automatic filling machine after completion of the filling operation to determine the average fill level of the containers are described. Averaging may be accomplished by a block averaging system that averages the fill level for selected groups of the filling heads of the machine, averages the fill level for a selected filling head of the machine or provides continuous averaging of all of the filling heads of the filling machine. The monitoring system may also employ a synchronization circuit to insure accuracy of the fill level averaging accomplished by the system. Fill level signals generated by inspection of each container being conveyed from the filling machine may be stored temporarily while synchronization is confirmed between a selected number of the filling heads of the machine and the number of containers filled by the filling heads of the machine during each filling cycle thereof. (Official Gazette)

18780 PROFILE GAUGING SYSTEM. Beckage, T.; Locks, W. S. (to Weston Instruments Inc.). US Patent 3,822,383. 2 Jul 1974. Filed Date 13 Apr 1973. 6p.

A thickness profile gauging apparatus, particularly for use with metal strip, in which first and second radiation sources irradiate the strip and first and second receivers detect radiation attenuated by the strip and produce signals representative of strip thickness is described. The receiver signals are converted into pulses having durations representative of signal amplitude and the pulses are integrated to produce a difference signal which is then sampled and held. The pulse converters are sequentially activated so that the respective receivers are gauging portions of the strip along the same transverse line, the sequential activation being controlled by a delay generator responsive to a strip velocity input signal. At least one of the radiation source-receiver pairs is transversely movable to scan the strip width and a center line switch produces a signal when the two gauges are examining portions of the strip on the same longitudinal line of the moving strip. Circuit means responsive to the center line signal causes a sample of the thickness difference information at that line to be held and provided as a drift correction signal. Subsequent difference signals are then combined with this correction signal to produce a continuous profile output, the correction signal compensating for drift in the two converters and detectors. (Official Gazette)

18781 NEUTRON ABSORPTION AND OXYGEN LOG FOR MEASURING OIL CONTENT OF FORMATION. Neumann, C. H. (to Chevron Research Co.). US Patent 3,817,328. 18 Jun 1974. Filed Date 21 Aug 1972. 12p.

This invention discloses a method for accurately determining changes in the fractional-volume oil and gas content of a reservoir from a cased well bore. The first step of the invention is to record the response of both a thermal-neutron-decay-time log and a neutron activated oxygen log to a reservoir formation traversed by the well bore. A purposeful change is then made in the oil saturation in a given region of the formation surrounding the well bore by injecting fluid under sufficient pressure to displace the connate fluids. This change can constitute the removal of substantially all the oil or the removal of as much oil as can be displaced by a proposed flooding technique. The combination of the thermal-neutron-decay-time log and the oxygen log is then run again to record the response of the same given region. The difference in the coil content around the well bore is then determined from the differences between the two sets of logs in a manner whose details are described. The method can be modified to measure changes in fluid content over long periods by running the combination of the thermal-neutron-decay-time log and the oxygen log when knowledge about current saturations is desired. The oil content between the first and second logging runs can have been changed only by production of fluids from the reservoir. (Official Gazette)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

18782 (AD–771426) BAR GAP RADIATION TEST. Final Report, October–December 1973. Russell, D. A. (Boeing Co., Seattle, Wash. (USA)). Dec 1973. Contract N00014-74-C-0064. 70p. (D–180-17847-1). NTIS $3.50.

A test program was conducted for investigating the effects of proton and ultraviolet radiation and thermal cycling on U. S. Navy

satellite solar panels. Government-supplied test panels were placed in a vacuum chamber and exposed alternately to 200-keV protons to a fluence of 10 to the 15th power p/sq cm, to 270 hours of ultraviolet radiation at a one sun rate, and to 21 thermal cycles. The performance of the test panels in the form of I-V curves was measured in situ before the start of testing and periodically throughout the test. (auth)

18783 (JPRS-62250, pp 1-16) EFFECT OF RADIATION ON THE VOLT-AMPERE CHARACTERISTICS OF TUNNEL DIODES. Mishchenko, B. G. Translated from Poluprov, Prib. Ikh Primen.; Sb. Statei; No. 27, 3-17(1973).

Results of studies on radiation effects on volt-amp characteristics of tunnel diodes are presented and discussed. It is concluded that the tunnel diode is one of the semiconductor devices most resistant to radiation. Its volt-amp characteristics practically do not change for integral flows of neutrons, protons and electrons in the order of 10^{15} particles/cm^2. (WHK)

18784 (N-71-34036) SOLAR CELL RADIATION DAMAGE EXPERIMENT. Quarterly Report, 28 March-27 June 1971. (Hughes Aircraft Co., El Segundo, Calif. (USA)). 27 Jun 1971. Contract NAS5-11677. 33p. (NASA-CR-121614). NTIS.

High accuracy data permitting a technical evaluation of the effects of the space radiation environments on solar cells is discussed. The flight experiment consists of a small solar panel mounted externally on the environmental measurements experiment (EME) package, which will interface with the spacecraft. The solar panel has a total of 80 solar cells, representing 16 solar cell configurations. Thirteen solar cell configurations will be mounted to the rigid panel portion of the solar panel and three configurations will be mounted to the flexible panel. In addition, the experiment has two signal processor units required for data sampling and telemetry. The solar cell experiment will be activated at programmed intervals to obtain voltage-current data for each individual solar cell and to obtain temperature and calibration data. In addition to the design and fabrication of the flight experiment, a ground test program will be run. Data resulting from this program will be used as an aid in selecting the solar cell configurations for the flight experiment. The program includes evaluation of the effects on solar cells and solar cell assemblies under an environment which simulates both synchronous electrons and low energy protons. (auth) (STAR)

18785 (N-72-17762) RADIATION EFFECTS ON ELECTRONIC PARTS. Revision A. Johnson, W. S. (Sterling (Walter V.) Inc., Los Altos, Calif. (USA)). 18 Jun 1971. Contract NAS2-4398. 159p. (NASA-CR-114364). NTIS.

A search of the literature concerning the long-term effects of nuclear radiation on electronic parts was conducted to determine the effects of radiation fields encountered on deep space missions to parts used in the Pioneer Spacecraft. Topics discussed include: the various types of radiation the spacecraft will encounter, effects of radiation on electronic parts, and estimates of the damage thresholds for transistors and integrated circuits used on the Pioneer Spacecraft. (STAR)

18786 (PEM-23) NUCLEAR EMP: SOME ASPECTS OF EMP HARDNESS ASSURANCE. Brown, G. L. (Resource Engineering and Planning, Falls Church, Va. (USA)). 1970. 15p. Dep. NTIS $4.00.

In this note, an EMP Hardness Assurance Program is considered to consist of (1) hardness integrity measures which are carried out during production (or retrofit) to insure a standard high level of hardness integrity in newly delivered systems, and after deployment to maintain hardness integrity during use, and (2) hardness evaluation tests which are performed to assess the hardness of both newly delivered and deployed systems, and to establish confidence in force hardness. Hardness integrity is established and maintained by the formulation, administration, and enforcement of purchase, manufacturing, and use controls. Both post production and production hardness integrity programs must be established if the force of deployed systems is to be hard. A number of different test concepts can be considered for the hardness evaluation of deployed or newly delivered systems. Tests can be performed on either a system or subsystem level, for example. An approach which was used to formulate and compare test concepts for one major weapon system is described in the note. The most straightforward method of evaluating the EMP hardness of a system is by performing system level simulation tests, when such tests are practical. When simulation tests are performed at field strengths which are less than threat level, a number of uncertainties are involved which reduces confidence in conclusions concerning the hardness of the force. If threat level tests are performed, the confidence level in force hardness can be established statistically. It may be possible to reduce the number of systems which must be tested by performing simulation tests with higher than threat level fields. (auth)

18787 RADIATION EFFECTS IN N-CHANNEL MOSFETS. Onnasch, D.; Reimerdes, H. P. (Institut fuer Strahlenschutz, Stohl, Ger.). Solid-State Electron.; 17: No. 7, 663-666(Jul 1974).

The radiation damage of commercially available n-channel depletion MOSFET's (3N128) is investigated up to a dose of 6 Mrad (SiO_2) Co-60 γ-rays. The upper bound of admissible radiation dose for these devices is about 100 krad (SiO_2) owing to the decrease of forward transconductance. The change of the turn-on-voltage is less than 1 V. C-V characteristics obtained by measuring the MOS charging current in response to a linear voltage ramp point to the growth of interface states with a monoenergetic level below the conduction band of Si. (auth)

18788 EFFECTS OF GAMMA RADIATION ON SEMICONDUCTOR SURFACE BARRIER DETECTORS. Tang, M. D.; Wu, S. S. (National Tsing Hua Univ., Hsinchu, Taiwan). Nucl. Sci. J. (Taiwan); 8: No. 3-4, 27-40(Dec 1971).

The changes in detector performance produced by gamma ray irradiation from a ^{60}Co source have been studied. It is shown that the resolution began to deteriorate rapidly after a total dose of about 10^7R, and soon a secondary peak of lower pulse height began to appear, increasing in size with further damage. The increase in leakage current occurred in the same integrated flux range but with less significance. Reasonable agreement exists between the theoretical predictions and experimental data. (auth)

18789 ROLE OF RADIATION DAMAGE ON THE CURRENT-VOLTAGE CHARACTERISTICS OF p-n JUNCTIONS. Ashburn, P.; Morgan, D. V. (Leeds Univ., Eng.). Solid-State Electron.; 17: No. 7, 689-698(Jul 1974).

The effects of radiation damage on the current-voltage characteristics of silicon p-n diodes were studied. Radiation damage was introduced by the implantation of carbon ions into the depletion region of the device. The physical properties of the damage center were examined by means of thermally stimulated current measurements, and by the measurement of the temperature dependence of the reverse leakage. The results at low implantation doses are explained by means of a single level Shockley-Read-Hall model, while at higher doses, charge compensation effects are introduced. Capacitance-voltage measurements are used as a means of verifying these conclusions, and further useful data is obtained from the results of low temperature annealing experiments. (auth)

Miscellaneous Instruments

Refer also to abstract 20366.

18790 (HWS-10005) CONTENTS OF THE HANFORD PLANTS STANDARDS INSTRUMENT BOOK AS OF MARCH 18, 1974. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 1974. 116p. Dep. NTIS $9.00.

Standards are given for panels and cabinets; equipment installation (including air pressure reducing station, orifice flanges, orifice plate and flow nozzle, flowmeter orifice plates for bolted pipe flanges, flowmeter in vertical steam lines, and dip tube assemblies); special equipment (ionization chambers and data acquisition equipment); underground installations (direct burial tubing installations and marker flag and post for UG tubing and piping); instrument specifications (piping and wiring of instrument panels and thermocouples and thermocouple extension wire); and instrument guides for (1) sizing flow restricting orifices, (2) instrument tubing and fittings, (3) selection of pneumatic control valves, (4) selection of process control instruments, and (5) instrument air systems. (WHK)

18791 (ICP-1049) TANK DEPLETION FLOW INSTRUMENTS. Georgeson, M. A. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs-Operations Office). May 1974. Contract AT(10-1)-1375. 25p. Dep. NTIS $4.00.

A new flow detection and control system using a principle of tank depletion is described whose flowrate accuracy falls within $\pm 1\frac{1}{2}\%$ of true flowrate. The flow systems electronic instruments utilize transistor-transistor logic and operational amplifiers. Flowrate is measured without need for an in-line flowmeter. Flow is determined from the rate of level change in the reference vessel. (auth)

18792 (JINR-10-7070) USE OF THE 7220-M PROGRAM CONTROLLER IN A PHYSICAL EXPERIMENT. Belik, V. N.; Elizarov, O. I.; Zhukov, G. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1972. 23p. (In Russian). INIS.

Methods are described for using a programmed controller (7220-M) in physics experiments, e.g., one with other modules in a standard SAMAS. Algorithms are given for several experiments. The work was done in the Neutron Physics Laboratory. (tr-auth)

18793 (JINR-13-7021) GENERATOR OF PRECISE AMPLITUDE PULSES. Sen Kan Sin; Trofimov, A. S. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1973. 5p. (In Russian). INIS.

A precise-amplitude pulse generator is described in which a current switch parallel to the load, operating in a pulsed regime, is included at the current output. This decreases the effect of instability of the internal resistance of the switch on the amplitude of the output pulses, thus increasing the stability. The generator was made at the Radioelectronics Department of the Nuclear Reaction Laboratory. (tr-auth)

18794 (KHFTI-72-8, pp 149-151) OPERATION OF SEMIAUTOMATIC MEASURING DEVICES ON LINE WITH THE "DNEPR-21" COMPUTER. Boriskin, V. N.; Vorob'eva, V. P.; Lysenko, A. A.; Lebedev, P. M.; Makarov, A. F. 1971. (In Russian).

A process for the input of data from semiautomatic measurement devices into the Dnepr-21 computer by using group input installations is described. The input installation consists of a symbol register, a convolution gate, input inverter, shift register, priority unit, and a demand trigger. The output of the control data from the semiautomatic devices occurs according to channels used for command of the fast program exchange. The group input installation maintains operation with the semiautomatic devices but if necessary its number can be increased to 16. (tr-auth)

18795 (NASA-SP-5936(02)) CABLES AND CONNECTORS. A Compilation. (National Aeronautics and Space Administration, Washington, D. C. (USA)). 1974. 21p. NTIS $1.00.

Twenty-four technical briefs on cables and connectors are included. Subjects include technology relevant to the employment of flat conductor cables and their adaptation to and within conventional systems and maintenance and service technology. (WHK)

18796 (RCN-203, pp 314-318) SYSTEM OF MODERATING NEUTRON MIRRORS TO PRODUCE AN INTENSE BEAM OF POLARIZED THERMAL NEUTRONS. Stecher-Rasmussen, F. (Reactor Centrum Nederland, Petten). Dec 1973.

From nuclear physics with thermal and resonance energy neutrons; Petten, Netherlands (22 May 1973).

The main feature of this system is the use of the thermal column of the High Flux Reactor in Petten as a neutron source instead of one of the beam channels. This gives a large increase in the solid angle. The system consists of four parts: a focusing precollimator of 85 moderating graphite mirrors; a focusing collimator of 85 Ni mirrors; a polarizing system of 85 magnetized Co-Fe (50%, 50%) mirrors; and a focusing collimator absorbing the unreflected, unpolarized neutrons from the third part. A sketch of the system is given. It is estimated that a flux of polarized thermal neutrons of 5×10^8 n/cm^2-s can be obtained. The dimensions of the polarized beam are such as to allow use of the beam by two experiments simultaneously. (1 figure) (RWR)

18797 (TID-20893(R4)) STANDARD NUCLEAR INSTRUMENT MODULES. Adopted by AEC NIM Committee. Costrell, L. (National Bureau of Standards, Washington, D. C. (USA)). Jul 1974. 31p. Dep. NTIS $4.75.

An addendum to the module specifications (TID-20893) to supply information on the technical advances is presented. A NIM specifications drawing list is included. (WHK)

18798 MODULATION TRANSFER FUNCTION AND INFORMATION CAPACITY OF UNFOCUSSED RECTANGLE SLIT COLLIMATOR. Nishizawa, K. (Nagoya Univ.). Kaku Igaku; 11: No. 1, 1-6(Feb 1974). (In Japanese).

The information transmitting character of unfocussed rectangle slit collimator systems, which are used for registration of radionuclides in the human body, was investigated using the modulation transfer function (MTF) and entropy (information capacity). Results and conclusions are given. (WHK)

18799 METHOD FOR NONDESTRUCTIVE DENSITOMETRIC MEASUREMENT OF SMALL VOLUMES INSIDE IRREGULARLY SHAPED NON-UNIFORM OBJECTS. Clarke, R. L.; Van Dyk, G. G. (to Atomic Energy of Canada Ltd.). US Patent 3,809,904. 7 May 1974. Priority date 24 Nov 1971, Canada. 6p.

In determining the electron density of a small selected volume inside an irregularly shaped non-uniform body using radiographic techniques there has always been a dependence on the absorption of radiation in the medium surrounding the selected volume. The present invention allows the measurement of the electron density of a small volume within a non-homogeneous medium by manipulation of the apparatus. This manipulation removes the dependence of the measurement on the absorption of the X-ray or gamma-radiation in the surrounding medium. (Official Gazette)

18800 TECHNOLOGY AND USE OF W-Re THERMOCOUPLES. Schley, R.; Matteudi, G. (CEN de Saclay, Gif-sur-Yvette, France). High Temp. - High Pressures; 5: No. 1, 111-120(1973). (In French).

From 3rd European conference on thermophysical properties; Turin, Italy (20 Jun 1972).

Different ways of making W-Re thermocouples are described. The difficulties encountered are outlined, and in order to solve them the individual components (the wires, insulation, sheaths), assembly operations, and methods of making the hot junctions are examined. Some conclusions are given with regard to drawing up suitable specifications. Finally, a few applications of W-Re alloy thermocouples in nuclear and other fields are outlined. Although many problems remain to be solved to ensure their adequate reliability, these thermocouples have in recent years been widely used for measuring temperatures in the range 1200 to 2200°C. (auth)

18801 IMPROVEMENTS IN OR RELATING TO MASS SPECTROMETERS AND MASS SPECTROMETRY. Merren, T. O. (to Associated Electrical Industries Ltd.). British Patent 134,895. 20 Mar 1974.

Reference is made to the type of mass spectrometer described in BP 1161432, with which ion beams are simultaneously analyzed in a common analyzer. With this arrangement many kinds of comparative analysis are possible, and it has been found that with a modification of this arrangement studies of metastable ions are possible. By suitable choice of an auxiliary ion beam deflecting field, ions passing through can be either substantially only metastable ions formed between the common ion beam deflecting field and the auxiliary ion beam deflecting field, or the parent ions of the metastable ions. The spectrometer is preferably double beam in operation, and the ion beam may be single or double focusing. The method of use is described. (UK)

18802 NEUTRON SCREEN. Desandre-Navarre, C.; Guemas, P.; Pinault, F.; Renavot, J. M. (to Commissariat l'Atomique Energia). French Patent 2,167,394. 14 Jan 1972. 7p. (In French).

A neutron screen is described. It consists of an aluminium envelope having parallel walls, these walls defining a volume through which a variable concentration neutron absorbing solution (boric acid) flows. The absorbing power of the screen increases with the concentration of the boric acid. (FR)

18803 IONIZING RADIATION APPARATUS AND METHOD FOR ANALYZING FLOWING SUBSTANCES. Boswell, C. R. (to United Kingdom Atomic Energy Authority). US Patent 3,823,316. 9 Jul 1974. Priority Date 10 Aug 1970, United Kingdom of Great Britain and Northern Ireland. 8p.

Methods and apparatus are disclosed for analyzing a flowing sample to detect one substance therein having a predetermined half-life, or two (or more) substances having respectively different half-lives. The sample flows past a first location, where it is irradiated with neutrons, and then through a single detecting location or two or more serially arranged detecting locations (according to the number of substances to be detected) where the radiation is detected for subsequent analysis of its spectrum. When detecting one substance, it is proposed to select a flow rate in relation to the particular delay volumes in the system such that the radiation activity is a maximum at which value it is little dependent on small changes in the flow rate. This flow rate would be different for each of two substances to be detected, and, in such a case, it is proposed to use a very high flow rate such that the dependence of the activity of flow rate changes is again small. As an alternative, it is proposed that the respective delay volumes in the system between the irradiating location and each of the two detecting locations be so selected in relation to the respective half-lives of the two substances to be detected that there is a single flow rate which gives maximum activity at both of the two detecting locations. (Official Gazette)

18804 ELEKTRONNAYA APPARATURA NA LINII S EVM V FIZICHESKOM EKSPERIMENTE. (Electronic Apparatus On-Line with a Computer in Physics Experiments.) Kolpakov, I. F. Moscow; Atomizdat (1974). 232p.

Questions on the use of electronic apparatus used in physics experimental installations on-line with a computer are examined. Third-generation electronic apparatus for physics experiments using scintillation counters and proportional wire chambers on-line with computers are examined. Special attention is given to

installations connecting detectors and electronic apparatus with computers, external installations (specifically computers) used in experiments and for control of physics installations. It is shown that CAMAC systems are the basic electronics of the third generation for physics experiments. Examples of electronic apparatus of physics installations performing in these systems are given. (tr-auth)

18805 RECENT IMPROVEMENTS IN THE ION ANALYZER AND TYPICAL EXAMPLES OF APPLICATIONS. Rouberol, J. M.; Basseville, P.; Lenoir, J. P. (Societe CAMECA, Courbevoie, France). pp 409-415 of Proceedings of the Sixth International Conference on X-Ray Optics and Microanalysis. Shinoda, G. (Ed.). Tokyo; Univ. of Tokyo Press (1972).

From 6th international conference on x-ray optics and microanalysis; Osaka, Japan (5 Sep 1971).

A Type IMS 300 ion analyzer, discussed at the last x-ray optics and microanalysis congress three years ago, has been continuously improved as compared to the prototype. The major improvements are the replacement of primary ion source from initial radio frequency type to duoplasmatron type, increase of mass resolution $M/\Delta M$ up to the order of 1000, and adoption of ion detector and counting system. The ion detector consists of a scintillator and a photomultiplier coupled to the counting system built around a 200 channel multiscale counter. The ion analyzer has a series of essential advantages over the electron probe, namely: (1) no limit to the range of elements that can be analyzed; (2) possibility of isotope analysis; (3) high sensitivity for bulk analysis; (4) possibility of in-depth analysis; and (5) high speed of recording the pictures of chemical distribution. (JA)

18806 ELEMENT AND ISOTOPE ANALYSIS WITH THE ION PROBE MASS SPECTROMETER. Nishimura, H.; Fujiwara, T.; Okano, J. (Osaka Univ.). pp 431-437 of Proceedings of the Sixth International Conference on X-Ray Optics and Microanalysis. Shinoda, G. (Ed.). Tokyo; Univ. of Tokyo Press (1972).

From 6th international conference on x-ray optics and microanalysis; Osaka, Japan (5 Sep 1971).

A simple and small ion probe mass spectrometer was fabricated that consists of an ion source for producing primary ions, a target system, a 20-stage secondary electron multiplier, a double focusing mass spectrometer, and three pumping systems which permit 10^{-7} torr vacuum. Its detectable limit, for example that of boron in silicon, was investigated. It was roughly 40 ppb. As for the detection of multiply-charged ions, further systematic investigation is now being carried out. Measurements have been performed on the determination of boron concentration in silicon, the distribution of Li, Mg and Fe in a stony meteorite, and lithium isotopic ratio in stony meteorites. It was found that the distribution of lithium strongly correlated with that of magnesium, but it did not correlate with that of iron. (JA)

18807 DESIGN AND EXPERIMENTAL RESULTS OF A SHIELDED ELECTRON PROBE MICROANALYZER FOR HIGHLY RADIOACTIVE SPECIMENS. Bazin, J. (CEN de Saclay, Gif-sur-Yvette, France); Vignesoult, N.; Roussel, E.; Conty, C.; Guernet, J. pp 789-794 of Proceedings of the Sixth International Conference on X-Ray Optics and Microanalysis. Shinoda, G. (Ed.). Tokyo; Univ. of Tokyo Press (1972).

From 6th international conference on x-ray optics and microanalysis; Osaka, Japan (5 Sep 1971).

The microanalysis of highly radioactive specimens presents specific difficulties regarding radiation protection. Two techniques facilitate this type of analysis. A shielded microprobe was designed on the basis of the safety standard of 2.5 mrem/h. In practice, however, operators will be exposed to much lower doses because of the working time and distance. After a brief description of the method of transfer, shielding, specimen stage, x-ray spectrometers, monochromators and specimen preparation, photographs of an example specimen are shown, which were the result of experimental irradiation of the nuclear fuel consisting of UO_2 nodules in a zirconium matrix. Specimen activity was 10 ± 2 curies at 0.75 MeV, and the background for each of four spectrometers was roughly 250 cps for the closest position of crystal, and 25 cps for the farthest without using pulse height analysis. (JA)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstract 18271.

18808 (K-GD-505(Pt.5)) BACKGROUND INFORMATION ON THE HEAT EXCHANGE SYSTEM FOR CIP/CUP: STRUCTURAL DETAILS AND MAINTENANCE HISTORY OF THE K-31 AND K-33 COOLING TOWERS. Uglow, R. R. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). May 1974. Contract W-7405-eng-26. 32p. Dep. NTIS $4.75.

A description of structural details is given for the K-862 "E" and the K-892 "G" and "H" cooling towers. These towers serve the K-31 and the K-33 process buildings, respectively. A maintenance history for both cooling towers is also included. (auth)

18809 INFLUENCE OF STAGE SEPARATION FACTOR ON SQUARED-OFF CASCADES. Yamada, T.; Ishii, B. (Mitsubishi Atomic Power Industries, Inc., Tokyo). J. Nucl. Sci. Technol. (Tokyo); 11: No. 2, 58-64(Feb 1974).

An example of optimization problem for the design of squared-off cascades to be incorporated in uranium enrichment plants utilizing gaseous diffusion is solved from an economic point of view, whereby minimization is obtained of the plant annual expenditure expressed in terms of simple cost functions. The equi-step squared-off cascade is studied. The salient features of such a cascade are illustrated by a comparison of the cascade performance between one aimed at minimum plant annual expenditure and one aimed at minimum total flow rate. For the first-mentioned form of optimized cascade, the influence of the stage separation factor on plant economics is studied. The discussion covers the determination of optimum waste assay, and the exponential relationship between the enrichment coefficient and plant economics. The economic considerations affecting the stage separation factor are summarized in sensitivity curves relating this factor to changes in various economic indicators. (auth)

18810 TOWER PACKINGS WIN NEW END-USES. Can. Chem. Process.; 58: No. 2, 16-18(Feb 1974).

New applications of tower packings in the Canadian heavy-water industry and in natural-gas processing are discussed. The Sulzer CY mesh packing, used to upgrade heavy water from 15% to 99.8% at CGE's Port Hawkesbury plant and Ontario Hydro's Bruce plant, is described with respect to operation, efficiency and advantages. Sulzer's original process for amine-based deuterium separation is currently being considered by Atomic Energy of Canada, Limited as an alternative process. Norton packings for removing residual sulfur dioxide from waste gases in plants processing natural gas are also discussed. (GWC)

18811 URANIUM ENRICHMENT. Wyart, P. (Electricite de France, Paris). Rev. Fr. Elec.; 47: No. 244, 2-9(1974). (In French).

The two uranium isotope enrichment processes, gas diffusion and ultracentrifugation are recalled. The European projects EURODIF and URENCO are based respectively on these two processes. The financial aspects, production capacities, and electricity consumption features of these two projects are discussed. The first investigation conducted by OPEN (Organization of Nuclear Energy Producers), a recently created organization, revealed the usefulness of both EURODIF and URENCO in Europe. It is shown that the special characteristics of the uranium enrichment market tend to further reinforce the ties between the interrelated electricity Public Services of Western Europe. (FR)

18812 FRENCH PROJECT FOR A GASEOUS DIFFUSION URANIUM ENRICHMENT PLANT. Tech. Mod.; No. 3, 13-16(Mar 1974). (In French).

Several reasons justify the construction of new enrichment plants using the French gaseous diffusion technique. France has completely mastered this technique and acquired considerable experience in weak enrichment gaseous diffusion plants as a result of the development and construction of the Pierrelatte plant, industrial research, and measurements conducted on the performance of materials intended for this purpose. The size of the potential market together with the restricted number of techniques available tends to encourage multinational cooperation in this field, emphasis being placed on fulfilling the enrichment requirements of Europe and the free world. The society, Eurodif, which was created by France, unites organizations and societies in Belgium, Spain, Italy and Sweden. This society has used a document established by the CEA as a base for discussions which have led to the decision to construct a gaseous diffusion enrichment plant on the Tricastin site in France. (FR)

18813 ISOTOPE SEPARATION. Chemla, M.; Perie, J. Paris; Presses Universitaires de France (1974). 246p. (In French).

Different isotope separation methods are presented: electromagnetic techniques; physicochemical methods; gas diffusion; ultracentrifugation; thermal diffusion; chemical equilibrium and isotopic exchange; and heavy water production. (FR)

18814 URANIUM: RESOURCES, SUPPLY, AND DEMAND. Joint Report of the NEA-OCED and IAEA. Paris; Bureau des Publications de l'OCDE (1973). 154p. (In French).

Also published in English.

This report brings up to date information on the resources, production, and demand of uranium. Uranium resources currently amount to 866,000 tons, an increase of about one third being added over the last three years. The annual production of U_3O_8 has remained stable (19,000 tons of U in 1972). This production capacity could be brought up to 50,000 tons by 1978. Estimations of future demands are based on predictions made by various countries. The annual demand for U is expected to be 60,000 tons in 1980 and almost double this figure by 1985. The envisaged dominance of light water reactors in the expansion of nuclear power foreseen over the next 10 y will require an annual amount of separative work units corresponding to between 30,000 and 40,000 tons at the beginning of the eighties. (FR)

18815 INDUSTRIAL OUTLINES OF URANIUM ENRICHMENT. Villani, S. (CISE, Milan). Energ. Nucl. (Milan); 21: No. 7, 393-415(Jul 1974). (In Italian).

The present situation of the uranium enrichment industry is illustrated both from the technical and commercial viewpoint. The processes taken into consideration are gaseous diffusion and centrifugation. Some cost data, both current and projected, are analyzed. Also the contract terms adopted by the main enrichment suppliers are briefly described. (auth)

18816 NOTE ON THE POWER CONSUMPTION OF A SEPARATING ELEMENT. Breton, J. P. (CEN de Saclay, Gif-sur-Yvette, France). Ann. Nucl. Sci. Eng.; 1: No. 4, 293-296(Apr 1974).

The large power consumption required for separating isotope mixtures by irreversible processes has been pointed out by Onsager (1939) and London (1961). General calculations, valid for both steady and unsteady flows of isotopic mixtures, are given. Using nonequilibrium thermodynamics, an upper bound is derived for the entropy efficiency. Then the power consumption is expressed in terms of the rate of change of a certain function and it is found that this latter is the product of the value function and the molar concentration. Finally, numerical values are obtained for two simple cases. (auth)

18817 CANADIAN INITIATIVE IN THE URANIUM ENRICHMENT FIELD. el Baroudi, M. Y.; Keeping, P. A. T. (Brinco Ltd., Can.). Nucl. Eng. Int.; 19: No. 217, 508-510(Jun 1974).

To meet part of the large and increasing demand for ^{235}U, Brinco, Ltd. proposes to organize, build, and operate a large scale U enrichment facility in Canada based on the gaseous diffusion process. The program, which aims at full capacity commercial operation by the early 1980's, is described. (UK)

18818 CHARACTERISTICS OF THE CALCULATION OF IDEAL CASCADES WITH ARBITRARY ENRICHMENT PER STAGE. Laguntsov, N. I. Sov. At. Energy (Engl. Transl.); 35: No. 3, 852-854(Sep 1973).

Translated from At. Energ. (USSR); 35: No. 3, 205-207(Sep 1973).

In previous papers the theory of the construction of symmetric and asymmetric two-component cascades with arbitrary enrichment $c^+ - c = \delta^+ = f(c,\theta)$ on each separation stage was considered. In principle, the equations obtained in this study are sufficient for determining all the parameters of the cascade. In addition, the overall characteristics of the cascade can be estimated. However, the calculations may involve difficulties owing to the fact that in one of the stages the value of the flow division coefficient θ is selected arbitrarily. As a result of this, there exists a family of ideal cascades from which one must select the optimal one. In addition, since the enrichment function depends on θ, the convergence of the calculations will depend substantially on the direction of the count, i.e., from waste end to product end or vice versa. In the particular case in which δ^+ depends only on the concentration

c, the calculation of the ideal cascade is unique. The above-mentioned characteristics of the calculation and criterion for the choice of the optimum value of the flow division coefficient are presented. (TFD)

18819 GAS CENTRIFUGE PROCESS FOR URANIUM ENRICHMENT: A PANDORA'S BOX. Salaff, S. Sci. Forum; 7: No. 3, 26-28(Jun 1974).

Britain, Holland, and West Germany have formed a consortium of state and corporate interests known as the Troika, for the industrial development of the gas centrifuge process for the enrichment of uranium. The evolution of the technology behind this partnership is discussed with reference to the political repercussions it may have with respect to France, Euratom and the IAEA. (CA)

Isotopic Power Sources

Refer also to abstracts 18464 and 18836.

18820 (COO-2155-9) BIOMEDICAL ENGINEERING SUPPORT. Annual Report, July 15, 1972 – August 14, 1973. Backman, D. K.; Sandquist, G. M.; Kolff, W. J. (Utah Univ., Salt Lake City (USA). Inst. for Biomedical Engineering). Jan 1974. Contract AT(11-1)-2155. 48p. Dep. NTIS $5.50.

During the contract year the following tasks were accomplished: Various configurations of the blood connectors from the blood pump were made and evaluated for fit in dead calves to determine an acceptable configuration. Designs of fixed molds were made and several implantable ventricle housings were fabricated and tested. The blood pump developed for bench model testing under the AEC practicability study was tested and evaluated for general performance including cardiac output, peak pusher cup forces, power requirements and efficiencies, inflow (venous) and outflow (arterial) pressures, and effects of outflow pressures and pumping rate upon cardiac output. Testing and evaluation included both in vitro studies on mock circulation systems and preliminary in vivo experiments in calves. Inert models of the radioisotope-powered thermal converter were implanted abdominally in eight calves to determine the chronic effects of the engine's weight and size. Results indicate that the converter can be successfully implanted in the abdomen to provide a total heart transplant system which includes the power supply. A successful quick connect system was designed, fabricated, and initially tested for implementing rapid connection of the atrial cuffs and arterial graphs to the blood pump. Surgical protocol for implantation of the blood pump into calves was prepared and three total heart replacement experiments in calves have been made. Results from these initial experiments are promising. (auth)

18821 (LA-5527-MS) PLUTONIA AERODYNAMIC DISK (PAD) SUMMARY REPORT. Burns, J. J.; Vorreiter, J. W. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1974. Contract W-7405-eng-36. 26p. Dep. NTIS $4.50.

Work on the Plutonia Aerodynamic Disk (PAD) fuel capsule concept began at the Los Alamos Scientific Laboratory the summer of 1971. This work was performed in cooperation with NASA's Ames Research Center and the NUS Corporation. The objective was to develop a modular heat source for radioisotope thermoelectric generators, with primary consideration for nuclear safety. Analytical effort has been directed to areas such as generator integration, launch abort, reentry, and postimpact. Experimental efforts have included air drop, hypersonic wind tunnel, and impact testing. Progress was also made in vent development, clad compatibility, and fuel processing. Results are summarized in this report, particularly because the results identify basic fuel capsule characteristics that are desirable from a safety standpoint. Recommendations for future efforts are also included. (auth)

18822 (MLM-2123) PREPARATION OF UO_2 AND $^{238}PuO_2$ FUEL PELLETS FOR A SMALL HEAT SOURCE. Deaton, R. L.; Wiedenheft, C. J.; Zielinski, R. E. (Mound Lab., Miamisburg, Ohio (USA)). 14 Jun 1974. Contract AT(33-1)-Gen-53. 23p. Dep. NTIS $4.00.

Pressed and sintered PuO_2 fuel pellets were developed as an alternate fuel form for a small radioisotopic heat source. In initial development UO_2 pellets were prepared prior to extending the study to $^{238}PuO_2$. As a result of this study, ideal pellet dimensions, shape, and pressing parameters were determined; 27 UO_2 and 18 PuO_2 pellets were fabricated. (auth)

Radiation Sources

18823 COMMERCIAL RADIONUCLIDE DISPENSING. Tiffin, L. O. (Agricultural Research Service, Beltsville, MD). Nature (London); 249: No. 5456, 494(31 May 1974).

An error in the commercial dispensing of ^{59}Fe is reported, in which the γ-activity was only about 10% of that expected from the data sheet. Reasons for the error are discussed and means to avoid such errors are recommended. (UK)

18824 SPECTRUM STANDARD. Besant, C. B. (to United Kingdom Atomic Energy Authority). British Patent 1,348,430. 20 Mar 1974. 5p.

An apparatus for providing a standard neutron spectrum is described. Zero energy fast critical lattices have been used for such purposes, but are very costly and are not suitable for use as a standard test assembly which can be widely used for reliable and accurate fast reactor flux measuring techniques. The fast neutron spectra is produced by thermal neutron irradiation of ^{235}U. (UK)

18825 TESTING DOSIMETRIC AND RADIOMETRIC EQUIPMENT. Pontus, L. A. Meas. Tech. (USSR) (Engl. Transl.); 16: No. 12, 1762-1763(Dec 1973).

Translated from Izmer. Tekh.; 16: No. 12, 11(Dec 1973).

A mobile dosimetric testing laboratory (PPDL-1) for periodic testing of working dosimeters and radiometers as well as pulse counters is described. (WHK)

Design and Fabrication

18826 APPARATUS FOR ALTERNATELY IRRADIATING AN OBJECT BY MEANS OF AT LEAST TWO RADIATION SOURCES. Mattsson, G. A. (to Aktienbolaget Atomenergi). US Patent 3,821,555. 28 Jun 1974. Priority date 13 Aug 1971, Sweden. 8p.

This application discloses an apparatus for alternately irradiating an object by means of a radioactive source and at least one further radiation source. The sources are mounted in a holder pivotably arranged within a tubular housing being longitudinally displaceable in a bracket and having a collimator opening, a selected source being brought into radiation position aligned with said collimator opening by turning said holder. The holder is turned by means of a longitudinal armature or permanent magnet system coupled to said holder in said housing and being pivotable around a longitudinal axis due to magnetic action at any portion of its length, said magnetic action being provided by an electromagnet arranged in connection with said bracket. (Official Gazette)

18827 METHOD AND APPARATUS FOR THE IN-VESSEL RADIATION TREATMENT OF BLOOD. Culver, G. G.; Riemath, W. F. (to United States Atomic Energy Commission). US Patent 3,811,426. 21 May 1974. Filed Date 21 May 1973. 8p.

An apparatus and a corresponding method for the in-vivo radiotherapy of blood by irradiation of the blood within the blood vessel are described. The device includes a wire which has a straight section and small oppositely facing loops at each of its two ends. An active radioisotope-layer is deposited over the center portion of the straight section of the wire and this radioisotope-layer is sealingly covered with a coating-layer to prevent any leaking of the radioisotope into the blood. The wire is adapted for surgical implantation diagonally transverse a blood vessel in a manner so that the active radioisotope-layer lies fully within the blood vessel, while the end of the wire projects such that the two loops lie fully exterior to the blood vessel. Following the depositing of the radioisotope-layer and the coating-layer on the wire and sterilization of the wire, the device is surgically implanted diagonally transverse the blood vessel and is anchored in place with respect to the blood vessel by suturing through the loops. (Official Gazette)

18828 ISOTOPIC NEUTRON SOURCES FOR NONDESTRUCTIVE AND SIMULTANEOUS DETERMINATIONS OF SILICON AND ALUMINIUM IN ROCK ORES AND MINERALS. Gurna, S. S.; Bhatnagar, A. S. (Dept. of Atomic Energy, Delhi). Indian J. Pure Appl. Phys.; 11: No. 11, 805-810(Nov 1973).

A brief description of an irradiation assembly and its suitability for routine and simultaneous determination of Si and Al in geological samples is presented. Studies for minimization and accounting for the mutual interferences, based on the selection of irradiation position and use of cadmium filter, are described. Results of estimation of the two elements in some typical geological samples with Si content from 1 to 34% and Al content from 0.4 to 39%, are presented. The scope for further improvements in the technique devised, and the possibility of its general application to resolve the well known interference encountered in neutron activation analysis techniques are discussed. (auth)

Industrial Uses

Refer also to abstracts 18301, 18302, 18871, 18874, 18881, 18884, 18897, 18898, and 19013.

18829 (AEC-tr-7555) FOOD IRRADIATION. Report to the Government of Uruguay. Ortin, N. (Montevideo Univ. (Uruguay)). 1972. Translation of TA report No. 832. 33p. Dep. NTIS $4.75.

A program is described which is designed to advise the University of Montevideo (Uruguay) School of Agronomy on the development of study and work programs on gamma radiation uses for food preservation, to provide the equipment needed, and to train Uruguayan scientists in irradiation techniques. Information is included on: the organization of the advisory mission; personnel training; preparation of working programs for the irradiation of potatoes, onions, garlic, wheat, and fish; and implementation of the working programs. (LCL)

18830 PROCESS FOR THE RADIATION TREATMENT OF POLYETHYLENE. ZeppenFeld, G. (to Ve Textilkombinat Cottbus). US Patent 3,783,115. 1 Jan 1974. Filed date 23 Jul 1971. 4p.

A process is described for preparing cross-linked polyethylene fiber materials by means of high energy radiation comprising irradiating a polyethylene sheet material with a high dose rate, preferably $\geq 10^4$ rad/s under an inert gas cushion or in vacuum, with a radiation dose of between 5 and 20 mrad, preferably between 6 and 10 mrad and thereafter tempering the irradiated sheet material in a heating zone under an inert gas cushion or in vacuum at a temperature under the crystallite melting point and preferably at a temperature of between 80 and 120°C. (Official Gazette)

18831 TREATMENT WITH ELECTRON BEAM OF THE EXHAUST GAS FROM HEAVY-OIL COMBUSTION. Kawakami, W. (Japan Atomic Energy Research Inst., Takasaki); Kawamura, K. Denki Kyokai Zassh.; No. 602, 29-36(Dec 1973). (In Japanese).

By electron beam irradiation of heavy-oil combustion gas, desulfurization of about 90% at 3 Mrad is possible. Based on the result obtained, an actual apparatus was constructed. The exhaust gas from heavy-oil combustion is fed continuously through a chemical reactor, where the electron beam irradiation is made. In this way, sulfurous acid gas and nitrogen sulfide can be removed simultaneously from the exhaust gas. The products are sulfuric acid mist and solid matter. These are then removed with electric-precipitation dust collectors. Since it is a dry method, there is no problem of drainage treatment, etc. The problem in the actual application for industries such as thermal power plants is power consumption. (JA)

18832 IRRADIATION OF THE PAST. Masson, M. Sci. Avenir; No. 325, 258-261(Mar 1974). (In French).

The Nuclear project (applications of nuclear science to art) developed by the CEN at Grenoble is intended to facilitate the conservation of objects having cultural value. The same method (impregnation and irradiation) is used for both wood and stone. The result of such a treatment is to stop any deterioration under relatively economical conditions. Wood is transformed into a highly resistant material. The method is not only limited to ancient objects but can be used for modern materials (concrete) for which it has enormous potential. (FR)

18833 RADIOACTIVE STATIC ELECTRICITY ELIMINATOR. Olson, O. L. (to Nuclear Radiation Development Inc.). US Patent 3,818,545. 25 Jun 1974. Filed date 25 Aug 1971. 6p.

A radioactive device to remove static electricity charges including a radioactive foil maintained in a grounded housing protected by a grounded metal grid, so located and of such physical dimensions, as to afford maximum protection against physical contact with the active element and minimum physical and electrical shielding of the effective radiations is described. For applications involving extremely high static charges, or where complete removal of static charges is essential, the grid may also incorporate metal brushes. In the latter version, the radioactive foil creates a region of high density ionization adjacent to the opening in the housing, with maximum density enveloping the points of the brushes, greatly enhancing the normal effectiveness of the brushes and making the device capable of effectively removing a wide range of static electrical charges and finds great use in the elimination of static electricity from moving materials such as paper, plastic, clothing, etc. created during their processing operation. (Official Gazette)

18834 RADIOACTIVE TRACER SYSTEM TO INDICATE DRILL BIT WEAR OR FAILURE. Fries, B. A. (to Chevron Research Company). US Patent 3,818,227. 18 Jun 1974. Filed date 18 Aug 1972. 8p.

A radioactive tracer system is described for indicating drill bit wear or failure utilizing radioactive krypton-85 in clathrate form, in the form of water-soluble kryptonates, or dissolved in grease. Preferably the radioactive krypton is placed so that when drill bit wear or failure occurs, the radioactive krypton-85 is released and effectively becomes diffused in the circulating drilling fluid. At the surface, the radioactive krypton-85 gas is separated from the circulating drilling fluid by gas-mud separating means and is transported as a gas to a counting chamber where an accurate radioactivity count of beta rays released from the krypton is obtained. The beta rays indicate drill bit wear or failure when detected above the normal background radioactivity of the recirculating drilling fluid. The radioactive krypton may also be implanted in the teeth or other surfaces of the cones of drill bits or implanted in the shirttail or other body parts of the bit. (Official Gazette)

18835 IRRADIATION: FRANCE HAS ALLOWED HERSELF TO BE OVERTAKEN. Vidal, P. (Conservaome Industrie, Courbevoie, France). Aliment. Vie; No. 19, 75-81(Sep 1973). (In French).

Numerous advantages to be gained from the irradiation of foods are enumerated. The utilization of this procedure throughout the world is discussed. France possesses a high potential in the field of industrial irradiation; the only legislation existing in this field concerns the commercialization of irradiated potatoes. Further legislation is urgently needed to avoid foreign competition. It is possible in this way to envisage the production of better quality foods under more hygienic conditions and to solve various industrial and commercial problems of the food industry in the interest of the consumer. (FR)

18836 UTILIZATION OF TRANSURANIUM ELEMENTS AS HEAT OR RADIATION SOURCES. Enomoto, S. (Japan Atomic Energy Research Inst., Oarai). Nippon Genshiryoku Gakkaishi; 15: No. 8, 534-543(Aug 1973). (In Japanese).

Most of the nuclides in transuranium elements emit α particles or undergo spontaneous fission. Technology development to utilize these characteristics is proceeding in many countries of the world, especially in the United States. They are used as heat and radiation sources. Outstanding among them are the utilization of ^{238}Pu as the heat source or power source used in space, and as the small power source for medical treatment, the activation analysis and radiography with ^{252}Cf neutron source, the measurement with α-ray, γ-ray or x ray, and x-ray fluorescence analysis. From the safety consideration to high toxicity, the nuclides are made into suitable chemical form, which is then sealed in capsules. (JA)

18837 POSSIBILITIES OF APPLICATION OF A RADIONUCLIDE MEASURING VAN IN MECHANICAL ENGINEERING. Katzenmeier, G.; Volz, J. (Kernforschungszentrum Karlsruhe (F.R. Germany). Lab. fuer Isotopentechnik). Kerntechnik; 16: No. 4, 145-151(Apr 1974). (In German, English).

7 figs.; 1 tab.; 4 refs.

The most important possibilities of application of the radionuclide technique in mechanical engineering are briefly presented. The equipment and installation of the radionuclide measuring van of the laboratory for isotope technique are described which is designed for the safe and problem-free application of this technique directly at the client's works. The possibilities of application of this measuring van in mechanical engineering are shown by a series of typical examples of application. Two sections on radiation protection and costs supplement the descriptions of application to facilitate the decision of how far the radionuclide measuring technique using the measuring van can be usefully applied to the solution of particular problems. (GE)

18838 POTENTIALITIES AND LEGISLATIVE REGULATION OF FOOD IRRADIATION IN CZECHOSLOVAKIA. Wolf, A. (Charles Univ., Prague). Radioisotopy; 15: No. 2, 155-300(1974). (In Czech).

The potentialities of food irradiation are evaluated on the basis of both foreign experience and Czechoslovak research work. The experiences obtained with the irradiation of potatoes, onions, spices, gelatine, packing material, meat, milk, fats, beer and pastes are reviewed. The changes in biological value of irradiated food with regard to individual nutrients and the organoleptic changes are reported. The microbiological changes of food irradiation are treated separately. The aspects of wholesomeness of irradiated food, the problem of cumulated energy, the residual effect and the efficacy of the present toxicological methods are discussed at length. In conclusion, suggestions are made for the legislative regulation of food irradiation in Czechoslovakia. (auth)

18839 RADIATION SOURCES FOR RESEARCH AND INDUSTRY. Nucl. Eng. Int.; 19: No. 217, 504-505(Jun 1974).

Commercial Products has the responsibilities, within Atomic Energy of Canada Limited, for the development of new and improved applications for radiation and radioisotopes, the development and manufacture of related equipment and the marketing of these products and services. The three broad ranges which are briefly surveyed are medical products, industrial products, and radioisotopes. (UK)

18840 CHARACTERIZATION OF VOLATILES PRODUCED BY MICROBIAL METABOLISM ON RADURIZED AND NON-RADURIZED POULTRY AT REFRIGERATED TEMPERATURES. Freeman, L. R. Amherst, MA; University of Massachusetts (1973). 105p. University Microfilms Order No. 74-16,306.

Thesis (Ph. D.).

Some of the volatile compounds present at spoilage of refrigerated chicken breasts were identified. This was accomplished by collecting the total volatile condensate of the sample by means of high-vacuum, low-temperature techniques followed by fractionation of the total condensate to remove water and carbon dioxide yielding a center fraction. The components of the center fraction were subsequently analyzed by combined gas-liquid chromatography and mass spectrometry. A comparison was made of the volatile compounds produced from radurized and non-radurized chicken breasts stored at specific temperatures under both aerobic and anaerobic conditions. Fifty-eight isolates were randomly selected from fresh poultry, radurized poultry, and unirradiated spoiled poultry. These isolates were classified taxonomically and 9 of them which produced off odors on sterile chicken breasts were selected for subsequent analysis of their volatiles. A total of 22 compounds were associated with spoilage at various storage conditions. Thirteen of the 22 compounds were unique to unirradiated and aerobically spoiled samples. In addition, ethanol and methanol were also present in unirradiated samples stored anaerobically as well as aerobically. The remaining compounds were common to both radurized and aerobically stored unirradiated samples and included n-pentane, n-heptane, n-octane, 1-heptene, benzene, toluene, and acetone. Of the 15 compounds (including the two alcohols) which were present in the aroma of unirradiated aerobically spoiled samples, 9 were found on chicken spoiled at both 2°C and 10°C. Some of these 9 compounds are believed to be important contributors to the character and intensity of the spoilage aroma of raw chicken. These compounds included hydrogen sulfide, methyl mercaptan, dimethyl sulfide, dimethyl disulfide, methyl acetate, ethyl acetate, heptadiene, methanol, and ethanol. Of the 6 remaining compounds, xylene, benzaldehyde, and 2,3-dithiahexane were associated with spoilage at 2°C and methyl thiol acetate, 2-butanone, and ethyl propionate were associated with 10°C spoilage. All 9 compounds found in both 10°C and 2°C unirradiated aerobically spoiled samples were accounted for in the pure culture studies of the isolates, and are believed to be among the compounds associated with the spoilage odor of chicken. The Pseudomonas isolates could account for all 9 of these compounds, although some non pseudomonads isolates also produced some of these compounds. Those compounds found on both radurized samples and aerobically spoiled samples were considered not to play a significant role in the spoilage aroma since unirradiated spoiled chicken smelled distinctly different from radurized samples which had been stored. Six compounds were identified in pure culture studies that were not observed in chicken spoiled by the original mixed flora. These compounds were ethyl benzene, methyl propionate, hydrogen cyanide, methyl isopropyl sulfide, 2-propanethiol, and an unidentified compound of molecular weight 102. (Diss. Abstr. Int., B)

18841 EFFECTS OF GAMMA IRRADIATION ON CHANGES IN ACIDITY, VITAMIN C, AND NON-PROTEIN NITROGEN OF APPLES STORED IN A CONTROLLED ATMOSPHERE. Saito, Z.; Igarashi, Y. (Hirosaki Univ., Aomori, Japan). Hirosaki Daigaku Nogakubu Gakujutsu Hokoku; No. 20, 13-19(Jun 1972).

Jonathan apples were irradiated with ^{60}Co gamma radiation at doses of 0 to 200 K rad and stored at 0°C in a controlled atmosphere (CA) room (O_2 3%, CO_2 3%). Acidity of the apples irradiated with 200 K rad gradually decreased during the storage. Total and reduced-type vitamin C and non-protein nitrogen contents of apples decreased by gamma irradiation. However, total and reduced-type vitamin C and non-protein nitrogen contents of irradiated apples were kept at the same level after the storage for 6 months as those of non-irradiated apples. Another lot of Jonathan apples were irradiated at doses of 5 K and stored at 0°C for 4.5 months in 3 CA rooms (O_2 3 to 5%, CO_2 2 to 2.5%; O_2 3 to 5%, CO_2 below 0.5%; O_2 21%, CO_2 2 to 2.5%) and in a common refrigerated room. Effects of irradiation were not significant. Total vitamin C of the apples kept by the CA storage for 4.5 months decreased to 29 to 45%, depending on the atmospheric conditions and on the application of irradiation, of the initial content, whereas it was about 61% in the case of the apples kept by the common refrigerated storage. Some apples were γ irradiated up to 100 K rad before CA storage (O_2 3 to 5%, CO_2 2 to 2.5%). However, the effects of irradiation were not distinct. (auth)

18842 SPROUT-INHIBITION OF SAPPORO-KI ONIONS AND THE CHANGES OF CONTENTS OF NUCLEIC ACIDS IN THEIR INNER BUDS BY GAMMA RADIATION. Chachin, K.; Matsuzuka, M.; Honjo, H.; Ogata, K. (Osaka Prefectural Univ., Sakai, Japan). Nippon Shokuhin Kogyo Gakkaishi; 20: No. 4, 158-162(Apr 1973). (In Japanese).

The relationships between the delay of the time of gamma irradiation and the sprout inhibition of Sapporo-ki onions were studied, and the nucleic acid content in inner buds of the onions was also determined. The onions were irradiated with the doses of 3 to 15 Krad and stored at room temperature except for the constant temperature lots of 1°, 6°, and 20°C. Onions which were irradiated 2 weeks after harvest did not sprout completely. However, when irradiation time was delayed about 4 weeks after; the inhibitory effect of gamma radiation on the sprouting was remarkably reduced. In irradiated onions stored 3 weeks after harvest, their inner buds had elongated slightly, and it was similar to the state of inner buds of Senshu-ki onions in budding period. Moreover, a similarity between their inner buds was observed in the pattern of the chromatograms of nucleic acids separated by using a MAK column. The contents of s-RNA, r-RNA, and DNA of inner buds in irradiated onions decreased by about a half of those in unirradiated onions 2 months after irradiation, and there was no difference between the contents of nucleic acids in 5 Krad onions and in 15 Krad ones. (auth)

18843 EFFECT OF GAMMA-IRRADIATION ON ORGANOLEPTIC QUALITIES OF WIENER SAUSAGE. Kosaka, K. (Japan Meat Processors Association, Tokyo); Ozawa, S.; Danbara, H. Nippon Shokuhin Kogyo Gakkaishi; 20: No. 12, 559-566(Dec 1973). (In Japanese).

The change of organoleptic quality of Wiener sausage irradiated with 0.5 M rad of gamma radiation was observed. On the 2nd and 3rd day after irradiation, off-flavor was detected when the sausage was chewed and swallowed. The fading and deterioration of the color began on the 7th day, whereas the off-flavor faded and could hardly be detected without most careful observation. Although the off-flavor was not eliminated under cold storage (<10°C) or fried in vegetable oil, it was difficult to detect when heated for 5 to 7 min in 80°C water. (auth)

18844 SOME RESULTS OF GAMMA-UNIT APPLICATION FOR AGRICULTURE PRODUCTION TREATMENT. Lur'e, L. S.; Srapenyants, R. A.; Serebrenikov, V. S.; Voropsev, Yu. V.; Prokof'ev, N. S. pp 103-108 of Primenenie Izotopov i Yadernykh Izluchenii v Sel'skom Khozyaistve. I. Moscow; Atomizdat (1971). (In Russian).

In order to carry out individual experiments, to create the optimum irradiation conditions (homogeneity of the dose field and coefficient of use of the irradiation), to study a series of engineering questions arising during the establishment of a gamma unit for different purposes for agriculture, the VIESKH gamma unit, responding to the requirements mentioned, was constructed. A study of the effect of γ radiation during the pre-planting treatment of potato tubers and the pre-planting processing of seeds of squash was carried out with this installation. The nutrient quality of silage prepared from irradiated maize is discussed. The data obtained indicates the expediency of further expansion of work on the use of radiation processing in the agricultural industry. Work on the development of a regime for the radiosterilization of wool from anthrax-infected sheep is also discussed. (tr-auth)

LIFE SCIENCES

Radiation Effects on Biochemicals

Refer also to abstracts 18322, 18866, 18868, 18871, 18877, 18881, 18883, 18888, 18946, 18974, 18987, and 20548.

18845 (AED-CONF-73-482-7) PRIMARY EFFECT OF UV IRRADIATION: THE IMPORTANCE OF FREE RADICALS FOR THE UV INACTIVATION OF ENZYMES. Nemec, H. W. (Freiburg Univ. (F. R. Germany). Inst. fuer Biophysik und Strahlenbiologie). 1973. 5p. (In German). INIS.

From 4th scientific meeting of the Deutsche Gesellschaft fuer Medizinische Physik e. V.; Homburg/Saar, Federal Republic of Germany (4 Oct 1973).

A method for the uv-irradiation of enzyme suspensions is described which allows a simple determination of the energy absorbed by the enzyme. The uv-irradiation of trypsin in oxygen-free suspensions yields similar results as irradiation under vacuum. Long-lived free radicals were detected in tryspin by means of ESR spectroscopy after irradiation at 278°K. The unpaired electrons are mainly located at the C_α atoms of the polypeptide chain and at sulphur atoms of the cystine residue. Apart from the ESR measurements, the decrease in the enzymatic activity has been investigated, as well as the quantum yield for the radical formation and the inactivation. (INIS)

18846 (COO-1772-12) ABSENCE OF PHOTOREACTIVATING ENZYME IN CANDIDA ALBICANS, CANDIDA STELLATOIDEA, AND CANDIDA TROPICALIS. Miller, G. R.; Sarachek, A. (Wichita State Univ., Kans. (USA)). 1973. Contract AT(11-1)-1772. 8p. Dep. NTIS $4.00.

Extracts were prepared from Candida albicans, C. stellatoidea, C. tropicalis, and C. pseudotropicalis. To test for the possible presence of photoreactivating enzyme, these extracts were assayed for light-dependent ability to restore transforming activity to uv-inactivated Haemophilus DNA. Results showed that the photoreactivating enzyme was present in extracts of C. pseudotropicalis but not in extracts of the other species. (HLW)

18847 PHARMACOLOGICAL AND BIOCHEMICAL CONSEQUENCES OF LOCALIZED INTESTINAL IRRADIATIONS. Sactini, R.; Brard, E.; Killian, J. (Institut National des Sciences Appliquees, Villeurbanne, France). Compt. Rend. Soc. Biol.; 167: No. 8, 1129-1135(1973). (In French).

The effect of 800r of x-radiation on four substances closely connected with the functioning of the digestive tract was studied: acetylcholine, serotonine, cholinesterases, and oxydase monoamines. Acetylcholine and serotonine exhibit an initial inhibition which might be due to the direct effect of irradiation on the enzymes associated with their syntheses. Oxydases monoamines exhibit a more significant and longer lasting inhibition than cholinesterases. They appear to be more sensitive to radiation than cholinesterases and their resynthesis takes place more slowly. (FR)

18848 PHOTO-INDUCED REACTION OF CHLORAMPHENICOL WITH E. COLI RIBOSOMES: COVALENT BINDING OF THE ANTIBIOTIC AND INACTIVATION OF PEPTIDYL TRANSFERASE. Sonenberg, N.; Zamir, A.; Wilchek, M. (Weizmann Inst. of Science, Rehovoth, Israel). Biochem. Biophys. Res. Commun.; 59: No. 2, 693-696(24 Jul 1974).

On irradiation of 50S ribosomal subunits with ^{14}C-chloramphenicol, radioactivity becomes covalently attached to the ribosomes and irreversible loss of peptidyl transferase activity occurs. The label is distributed among most of the ribosomal proteins. Inactivation, but not covalent binding, was prevented when the irradiated mixture contained also erythromycin. (auth)

18849 ANNUAL REVIEW OF BIOPHYSICS AND BIOENGINEERING. Volume 3. Mullins, L. J. (Ed.). Palo Alto, CA; Annual Reviews Inc. (1974). 409p. $12.00.

Separate abstracts were prepared for two papers. An additional 12 papers are included on various aspects of biophysics and bioengineering. (HLW)

For abstracts of individual papers see: 18850 and 19073.

18850 CONFORMATIONAL CHANGES IN DNA MOLECULES. Frank-Kamenetskii, M. D.; Lazurkin, Yu. S. (Inst. of Atomic Energy, Moscow). pp 127-150 of Annual Review of Biophysics and Bioengineering. Vol. 3. Mullins, L. J. (Ed.). Palo Alto, CA; Annual Reviews, Inc. (1974).

Studies on conformational changes in DNA molecules are reviewed. Some topics discussed are: helix-coil equilibrium in DNA; fine structure of DNA melting curves; thermodynamic parameters of DNA; conformational changes in DNA at temperatures below the melting range; formaldehyde as a probe for DNA structure; and the role of conformational motility in the process of DNA damage under UV radiation. (HLW)

18851 PHOTOTRANSFORMATIONS OF FREE RADICALS IN UV-IRRADIATED POLYCRYSTALLINE PROTEINS. Formation of Peptide Group Radicals. Sud'bina, E. N.; Azizova, O. A.; Kayushin, L. P. (Pushchino-na-Oka Inst. of Biological Physics, USSR). Biofizika; 18: No. 4, 611-617(Jul 1973). (In Russian).

Polycrystalline proteins irradiated at 77°K showed different peptide groups. One radical was formed as a result of addition of electrons to the C=O group, while another (365 mμ irradiation) originated from the C-N. A paramagnetic center was formed in further conversion (550 to 600 mμ). The mechanism of radical transformation under uv irradiation was studied. (tr-auth)

18852 KINETICS OF THE CHANGES IN THE MOUSE HEMOGLOBIN FOLLOWING UV-IRRADIATION. Artyukhov, V. G.; Shmelev, V. P. (Voronezh State Univ., USSR). Biofizika; 18: No. 8, 497-501(May 1973). (In Russian).

The quantitative principles of photooxidation of mouse oxyhemoglobin by uv radiation was studied. The hemoglobin molecule in an aqueous medium was shown to be oxidized with a high quantum yield (0.164). The kinetics of change in absorption of uv-irradiated oxyhemoglobin solutions was studied at 20 to 50°C. Increasing the temperature increased the photooxidation rate. Increasing the radiation dose decreased the activation energy. (tr-auth)

18853 PHOTOREACTIVITY OF SOME LIGHT-SENSITIVE ESTROGEN DERIVATIVES. Use of an Exchange Assay to Determine Their Photointeraction with Rat Uterine Estrogen Binding Protein. Katzenellenbogen, J. A.; Johnson, H. J. Jr.; Carlson, K. E.; Myers, H. N. (Univ. of Illinois, Urbana). Biochemistry; 13: No. 14, 2986-2994(2 Jul 1974).

The photoreactivity of a number of photosensitive estrogen derivatives with the estrogen binding protein of rat uterus can be ascertained using a cytosol exchange assay. The competitive effect of estradiol localizes the reaction at the estrogen binding site and permits the assignment of a reaction efficiency for each compound—per cent of the binding capacity that is consumed upon photolysis. The kinetics of reaction of several azide and diazo derivatives is biphasic, the initial portion corresponding to the photolysis rate of the photosensitive function and the slower portion to the direct photolytic degradation of the binding protein. Reaction efficiencies of these compounds range from 0 to 21%. In certain cases there is a pronounced dependence on the orientation of the reactive function in the binding site. Investigation of a number of other chromophoric estrogens and antiestrogens shows some to be unreactive (benzil, o-iodophenol, o-nitrophenol, α-oximo ketone, stilbene, and styrene chromophores) and others to be highly reactive (20-51%; triarylethylene chromophores). As opposed to the biphasic kinetics of these derivatives, reaction of 6-oxoestradiol is cleanly first order. A reagent of this type is classified as "photoexcitable" (reversibly photoactivatable), while the others are "photolabile" (irreversibly photoactivatable). (auth)

18854 EFFECTS OF ULTRAVIOLET IRRADIATION ON BIOLOGICAL FUNCTIONS OF DNA AND RNA. Nozu, K. (Osaka Univ., Toyonaka, Japan). Annu. Rep. Biol. Works, Fac. Sci., Osaka Univ.; 19: 147-165(Feb 1973).

The experimental reports related to the ultraviolet-induced lesions of DNA and RNA molecules, and the effects of uv lesions on the biological functions of macromolecules, were briefly reviewed. Experimental efforts to analyze inactivation mechanisms of DNA and RNA by ultraviolet irradiation, and repair mechanism by ultraviolet damage, would surely be the right way to understand the principles of life—as, for example, the experimental efforts to analyze excision-repair mechanisms of uv lesions in DNA molecules have offered a decisive advantage for elucidation of the most important biological mechanisms, such as DNA replication or DNA recombination. Meanwhile, recently it has also become apparent that ionizing radiations such as x ray or γ ray cut the DNA strands in a specific manner, resulting in both single-strand breaks and double-strand breaks of polynucleotide chains of DNA, and the single-strand breaks of DNA are easily rejoined by an enzyme, polynucleotide ligase. (auth)

18855 EFFECT OF GAMMA-IRRADIATION ON EGG WHITE LYSOZYME IN AQUEOUS SOLUTION. Kume, T.; Sato, Y.; Umemoto, Y. (Nagoya Univ., Japan). Nippon Nogeikagaku Kaishi; 47: No. 9, 549-555(Sep 1973). (In Japanese).

The effect of γ irradiation on 0.3% lysozyme solution at pH 8.0 was studied as the fundamentals of the radiation preservation of egg white. The inactivation curve of lysozyme in aqueous solution was exponential and the value of D_{37}, the dose required to reduce the enzymatic activity to 37% of its initial value, was 0.35 Mrad. Enzymatic activity of lysozyme in egg white was slightly affected by irradiation. Thus it seemed that lysozyme might be protected from the influence of irradiation because of high concentration of protein in egg white. Irradiated lysozyme was subjected to Sephadex G-75 column chromatography. Area of the earlier fraction was increased with the increase of irradiation doses. The fraction had no enzymatic activity and the molecular weight estimated from elution volume was about 70,000. Ethanol had a protective effect which paralleled to their rates of reaction with OH radicals; this indicates that OH radical is primarily responsible for inactivation and aggregation of lysozyme. (auth)

Radiation Effects on Cells

Refer also to abstracts 18947, 18987, 18996, 20544, and 20547.

18856 (COO-3110-13) CELLULAR HEREDITY IN HAPLOID CULTURES OF SOMATIC CELLS. Comprehensive Report, 1971-1974. Freed, J. J. (Institute for Cancer Research, Philadelphia, Pa. (USA)). 1974. Contract AT(11-1)-3110. 19p. Dep. NTIS $4.00.

Genetic studies of cultured haploid cells are summarized for the period 1971 to 1974. Haploid cell strains were derived from haploid tissues of Rana pipiens (grass frog) embryos. The ploidy-independent yield of drug-resistant variant strains, and the lack of a recessive lethal effect in comparisons of haploid and diploid survival after mutagenic insult, implied that processes more complex than single genetic mutations played a role in generating stable phenotypic variation in cell culture. Studies on the effects of x radiation on survival showed that recessive mutations were not important determinants of x-ray survival in cultured haploid cells. (HLW)

18857 (SRO-735-3) STUDIES ON MECHANISMS OF MUTATION, RECOMBINATION AND GENE ACTION IN NEUROSPORA. Progress Report, October 1, 1973-September 30, 1974. Giles, N. H. (Georgia Univ., Athens (USA). Dept. of Zoology). 30 Jun 1974. Contract AT(38-1)-735. 29p. Dep. NTIS $4.50.

Results are reported from combined biochemical, immunological, and genetic studies of the qa system in Neurospora crassa, which comprises a cluster of four contiguous genes in linkage group VII. Tests were developed for uv-induced reversions in mutants. (CH)

18858 COMPARATIVE STUDIES OF THE EFFECTS OF CARCINOGENIC AND ANTITUMOR AGENTS ON THE DNA REPLICATION OF CULTURED MAMMALIAN CELLS. Makino, F.; Okada, S. (Tokyo Univ.). Mutat. Res.; 23: No. 3, 387-394(Jun 1974).

Cultured mouse L5178Y cells were exposed to several carcinogenic and antitumor agents. After exposure to one of the agents, the cells were labeled with [^{3}H]-thymidine for 20 min, and the DNA was subjected to alkaline sucrose gradient centrifugation immediately or after a chase period. This led us to classify the agents into 3 groups: uv, 4-nitroquinoline-I-oxide (4NQO), N-methyl-N'-nitrosoguanidine (MNNG), nitrogen mustard and Mitomycin C. These were characterized by 20-min DNA labeling patterns showing the formation of small DNA and by the slowing down of their subsequent elongation. Replicated DNA strands would have gaps where "damage" was present on the parental strands. Subsequently, gap-filling replication would occur with or withoug repairing damage, γ-rays. The 20-min DNA labeling profile displayed a larger size of DNA pieces and the subsequent elongation of this DNA was slightly affected. This is probably due to a preferential depression of initiation of DNA replication. Methyl methanesulfonate (MMS) and low temperature (28°). The 20-min DNA labeling patterns were qualitatively similar to, but quantitatively different from those of non-irradiated control. The rate of DNA elongation was slightly retarded. (auth)

18859 CAFFEINE-INDUCED ENHANCEMENT OF CHROMOSOME DAMAGE IN HUMAN LYMPHOCYTES TREATED WITH METHYL-METHANE-SULFONATE, MITOMYCIN C, AND X RAYS. Broegger, A. (Inst. for Cancer Research, Oslo). Mutat. Res.; 23: No. 3, 353-360(Jun 1974).

Two hypotheses have been put forward in the literature to explain the synergistic effect of caffeine with several mutagens: binding of caffeine to DNA, and inhibition of DNA repair. Autoradiographic studies with ^{3}H- and ^{14}C-labeled caffeine did not support the binding hypothesis. Caffeine enhanced in a synergistic way the amount of chromatid breaks and exchanges induced in human lymphocytes with methyl-methanesulphonate (MMS), mitomycin C (MC) and x-rays. The results are best explained if caffeine inhibits a post-replication repair process, particularly the filling-in of gaps in the newly synthesized DNA. (auth)

18860 POSTREPLICATION REPAIR OF DNA IN MOUSE LYMPHOMA CELLS. Zipser, E. V. New Haven; Yale Univ. (1973). 106p. University Microfilms Order No. 74-13,048. Thesis (Ph. D.).

A mammalian cell line (Fischer's L5178Y mouse lymphoma) shows evidence of a repair mechanism acting on DNA that is synthesized after ultraviolet-irradiation or cross-linking treatment. Pyrimidine dimers are formed in the DNA of uv-irradiated L5178Y cells at the rate of approximately one dimer per 8 to 9×10^8 daltons/erg/mm^2. DNA from irradiated cells was examined by sedimentation in alkaline sucrose gradients after lysis of cells directly on the gradient and exposure to low levels (200 to 2000 rads) of x irradiation. The DNA daughter strands synthesized in uv-irradiated cells are discontinuous at intervals corresponding to the spacing of pyrimidine dimers on the irradiated template strands. Low molecular weight DNA is made for at least four hours following irradiation, suggesting that little excision-repair of the template occurs during this time. The molecular weight of the discontinuous DNA increases to that of control DNA during incubation at 37°C, but 4 mM caffeine prevents this molecular weight shift from occurring and allows low molecular weight DNA strands to accumulate. DNA replicated after uv irradiation contains more single-stranded material than DNA replicated in unirradiated cells, as indicated by its behavior on benzoylated DEAE cellulose columns. These results suggest that DNA replication past ultraviolet photoproducts leaves gaps opposite in the newly synthesized daughter strands, and that a post-replication repair mechanism operates to rejoin the discontinuous regions. Cross-links have been identified in the DNA of L5178Y cells treated with 4,5',8-trimethylpsoralen and long wavelength uv light by hydroxyapatite chromatography. The DNA synthesized in treated cells is discontinuous at intervals approximately one-half to three-fourths the average distance between cross-links and is partially repaired upon incubation. These observations suggest that DNA polymerization may be interrupted by psoralen monoadducts and cross-links, as well as by pyrimidine dimers. DNA synthesized after uv irradiation was density-labeled with BrdUrd in FdUrd in order to allow the separation of daughter and parental strand DNA in alkaline cesium sulfate equilibrium density gradients, and to allow the identification of recombinant molecules of intermediate density. No evidence for intracellular recombination events involving regions of more than 1000 nucleotides was found in uv irradiated cells. (Diss. Abstr. Int., B)

18861 SPLIT-DOSE EXPERIMENTS WITH HYPOXIC CELLS. Implications for Fractionated and Low-Dose-Rate Radiotherapy. Hall, E. J.; Phil, D.; Lehnert, S.; Roizin-Towle, L. (Columbia Univ., New York). Contract AT-(11-1)-2343. Radiology; 112: No. 2, 425-430(Aug 1974).

From 59th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (25 Nov 1973).

Techniques of producing hypoxic populations of cultured mammalian cells by using high cell concentrations have been developed. Under these conditions, oxygen is still dose-modifying and the oxygen enhancement ratio is approximately 3. Split-dose experiments indicate that repair of sublethal radiation damage is completely inhibited if hypoxia is maintained both during the radiation exposures and throughout the storage interval between doses. These findings have important implications in practical radiation therapy: tumor cells at such a low level of hypoxia that repair of sublethal damage is inhibited are not protected by the hypoxia, provided the treatment is hyperfractionated. (auth)

18862 SPATIAL DISTRIBUTION OF HUMAN CELL SURVIVAL AND OXYGEN EFFECT IN A THERAPEUTIC HELIUM ION BEAM. Todd, P.; Martins, B. I.; Lyman, J. T.; Kim, J. H.; Schroy, C. B. (Pennsylvania State Univ., University Park). Cancer; 34: No. 1, 1-5(Jul 1974).

From fifteenth annual meeting of the American Society of Therapeutic Radiologists; New Orleans, LA (24 Oct 1973).

The survival of human kidney T-1 cells, based on colony formation, was determined in the presence and absence of oxygen as a continuous function of depth in a beam of high-energy helium ions from the Berkeley 184-inch synchrocyclotron. Cells were exposed while attached to plastic coverslips in holders that spaced them 0.25 cm apart along the beam path. In some samples oxygen was removed from the medium by metabolic depletion by freshly-irradiated cells. The original beam energy (910 MeV) was degraded by absorbers so that the residual range was 10 cm; a reciprocating ridge filter then spread the Bragg peak out to a width of 5.5 cm. Cell survival decreased as a function of depth, and the RBE of this beam at maximum depth (highest LET) was 1.4. At this point the OER was 2.2 ± 0.2, compared to 3.0 ± 0.3 at the point where the

minimum-LET beam entered the sample. At the minimum depth to which the Bragg peak was spread, the RBE was 1.1, and the OER was 2.3 ± 0.3. Beyond the stopping point of the beam there was no cell death detectable within the sensitivity of the experiments; for example, surviving fraction was 0.99 ± 0.05 at a point 0.5 cm beyond where the dose was 765 rads. (auth)

18863 SPATIAL DISTRIBUTION OF HUMAN CELL SURVIVAL IN A NEUTRON BEAM DESIGNED FOR THERAPY. Todd, P. (Pennsylvania State Univ., University Park); Schroy, B.; Attix, F. H.; Theus, R. B. Cancer; 34: No. 1, 33-38(Jul 1974).

From fifteenth annual meeting of the American Society of Therapeutic Radiologists; New Orleans, LA (24 Oct 1973).

The survival of cultured human (T-1 kidney) cells was determined at various locations in a tissue-equivalent liquid phantom irradiated with various doses of fast neutrons in the 10 × 10 cm collimated beam at the Naval Research Laboratory cyclotron. Conditions were: modal neutron energy = 17 MeV, dose rate = 60 rad/min, TSD = 125 cm, HVL = 11 cm tissue-equivalent fluid. When results were expressed in terms of cell inactivation as a function of dose, it could be seen that cell inactivation in all parts of the phantom was due to neutrons. For specified single doses at depth, cell isosurvival contours were plotted in two dimensions, and these contours were transformed to equivalent gamma isodose contours by using the gamma cell survival curve. The results of these experiments provide a preliminary indication that treatment planning with this neutron beam can be based on a space-independent, dose-dependent RBE. (auth)

18864 INTRAGENOMAL DISTRIBUTION OF DNA REPAIR SYNTHESIS: REPAIR IN SATELLITE AND MAINBAND DNA IN CULTURED MOUSE CELLS. Lieberman, M. W.; Poirier, M. C. (National Cancer Inst., Bethesda, MD). Proc. Nat. Acad. Sci. U. S. A.; 71: No. 6, 2461-2465(Jun 1974).

DNA repair synthesis was examined in mouse satellite and mainband DNA derived from confluent Balb/c 3T3 cells damaged with ultraviolet radiation or N-acetoxy-2-acetylaminofluorene. Two different approaches were used: Contact-inhibited cells were treated with hydroxyurea to reduce replicative synthesis to low levels; and bromodeoxyuridine was used to label newly replicated DNA in cells that had escaped contact inhibition. DNA was separated into mainband and satellite fractions in Ag^+-Cs_2SO_4 gradients. After treatment with either ultraviolet radiation or N-acetoxy-2-acetylaminofluorene, repair synthesis occurred to the same extent in mainband and satellite DNA. Repair synthesis increased over an ultraviolet radiation dose range of 30-200 erg/mm², and the extent of repair in the two DNA species was similar at each dose level. An analysis of the separated strands of satellite DNA from ultraviolet-irradiated cells indicated that the extent of repair is closely correlated with the availability of pyrimidines for cyclobutyl dimer formation and provided evidence that repair synthesis occurs at the site of damage. Within the precision of the experiments the results suggest that at least one group of highly repetitive, nontranslated DNA sequences is repaired to about the same extent as the rest of the genome. (auth)

18865 TUMOR CELL KINETICS FOLLOWING FRACTIONATED IRRADIATION. Clement, J. J. Chapel Hill, NC; University of North Carolina (1974). 157p. University Microfilms Order No. 74-15,318.

Thesis (Ph. D.).

The effect of fractionated irradiation on cell survival and cell progression of the Ehrlich ascites tumor was determined. The purpose of this study was to examine the possibility for designing effective multidose cell killing regimes based on consideration of cyclic cell radiosensitivity. Methods were developed for determining cell radiosensitivity as a function of cell stage and the time of occurrence of increased cell radiosensitivity following fractionates irradiation. The method for determining cell stage radiosensitivity consisted of relating mitotic activity and DNA synthesis following single-dose irradiation to fluctuations in cell survival following 2-dose irradiations. The method used to develop 3-dose fractionation intervals consisted of utilizing mitotic activity and DNA synthesis following selected 2-dose irradiations to predict periods of increased radiosensitivity. The plot of cell survival versus fractionation interval for 2 doses was characterized by a peak in surviving cells at 5 hours followed by a dip in survival at 9 hours and a subsequent plateau up to 24 hours between fractions. These data were interpreted on the basis of mitotic activity and DNA synthesis at the time of the second dose as representing repair of sublethal injury and the progression of a semisynchronous population from S-phase into sensitive G_2, M, and G_1 stages. Patterns of mitotic activity and DNA synthesis following 2-dose irradiation were dependent on fractionation interval. Intervals of 5 and 15 hours produced similar results interpreted as representing the independent progression of at least two independent age cohorts. A fractionation interval of 9 hours produced a response interpreted as a partial loss of cell synchrony produced by the second dose. The design of effective 3-dose cell killing regimes was approached in two ways. Either the second dose was timed to induce continued or increased cell synchrony, or the second dose was timed to deplete the cell population. The 3-dose regimes in which the second dose increased cell synchrony were more effective in terms of cell killing than regimes in which the second and third dose were delivered at predicted sensitive periods. Variations in 3-dose cell survival were consistent with the theory that the degree of synchrony induced in a cell population is the basic consideration in the design of effective cell killing regimes for short fractionation intervals. (Diss. Abstr. Int., B)

18866 INFORMATSIONNYE MAKROMOLEKULY PRI LUCHEVOM PORAZHENII KLETOK. (Information Macromolecules Following Radiation Injury to Cells). Komar, V. E.; Khanson, K. P. Moscow; Atomizdat (1972). 160p.

This book is devoted to one of the most pressing problems of radiobiology, the effect of ionizing radiation and chemical radiosensitizers on the structure and functional activity of the genetic apparatus of cells. Data concerning the effect of irradiation on the DNA and DNP, the role of the structural damage of messenger-RNA in the breakdown of the process of nucleic acid exchange and synthesis of albumin are discussed. The processes of catabolism and their role in the induction of radiation injury to the cells are examined. Special attention is given to the biochemical bases of the destruction of cells during interphase and also to the nature of the radiosensitivity of synchronous cell populations. (tr-auth)

18867 POSTREPLICATION REPAIR OF ULTRAVIOLET DAMAGE TO DNA IN XERODERMA PIGMENTOSUM, OTHER HUMAN AND MOUSE CELLS IN CULTURE. Fujiwara, Y.; Kondo, T. (Univ., Kobe, Japan). J. Radiat. Res.; 15: No. 2, 81-89(Jun 1974).

Two XP cell lines used, XP 1 and XP 3, are defective in unscheduled DNA synthesis and have Do values of 12 and 19 ergs/mm², respectively. These values are much smaller than the Do of about 100 ergs/mm² found for HeLa S 3 and human embryonic diploid F 1000 cells. This indicates that excision repair predominates in normal human cells. Mouse L 5 cells possess the reduced ability of unscheduled DNA synthesis which is only one third of that in HeLa and F 1000 cells, but are as uv-resistant as human cells of HeLa and F 1000. This suggests that L 5 cells may possess an enhanced ability of postreplication repair. Molecular evidence for this is that the change with uv-dose of the average size of post-uv synthesized DNA pieces in L 5 cells is more similar to that in HeLa cells than that in XP 3 cells. The characteristics of postreplication repair as revealed by alkaline sucrose sedimentation of DNA pieces taken from uv-irradiated human cells (XP, HeLa and F 1000) are as follows: Gaps are formed in newly synthesized DNA and subsequently filled in rather quickly. The gaps fully patched with BrdUrd chase are reformed by photolysis of the BrdUrd patches with near uv irradiation. The gap-filling is prevented by 2×10^{-3} M caffeine in human cells as is known for L 5 cells. All the cell lines tested, including two XP lines, show the postreplication repair ability. These results may support a model that the gaps which have been formed in newly synthesized DNA presumably opposite pyrimidine dimers in the parental DNA are filled in by de novo elongation of DNA chains. A possible aspect of uv carcinogenesis in XP is discussed in relation to DNA repair. (auth)

18868 EFFECT OF SUBLETHAL X-RAY DOSES ON THE FLUORESCENCE OF LEUKOCYTE NUCLEI IN EXPERIMENTAL ANIMALS. I. Changes in the Fraction of Leukocytes with Green Fluorescence Due to a Single Whole-Body Irradiation With 25, 50, and 100 R. Kolesar, D. (Comenius Univ., Bratislava). Bratislav. Lek. Listy; 59: No. 4, 406-414(Apr 1973). (In Slovak).

The application of fluorescence microscopy was studied for estimating the response of the organism to ionizing radiation, namely, in investigating color changes in the fluorescence of leukocyte nuclei in rats. Three groups of albino rats were exposed to a single whole-body x-irradiation at doses of 25, 50, and 100 R, respectively. Fluorescence microscopy showed that prior to irradiation, 96 to 100% of leukocyte nuclei in healthy animals had fluoresced bright green. Irradiation resulted in a decrease in green fluorescence. The maximum decrease was found in granulocyte nuclei, this 24 and 72 hours after exposure, depending on the dose. After a dose of 25 R, the maximum decrease amounted to 3.5% 24 hours after exposure, the dose of 50 R resulted in a 7.6% decrease, while in the third group the decrease reached 10.1%. The return to normal was observed after three days following exposure to 25 R and 14 days following exposure to 50 R. Agranulocytes showed considerably lower deviations in fluorescence changes and could not be made use of in diagnosis or prognosis. The dose of 100 R resulted in a statistically significant decrease in the proportion of the total number of leukocytes. (Nuclear Sci. Abstr. Czech.)

18869 INVESTIGATION OF RADIATION-INDUCED CHROMATID ABERRATIONS IN AMPHIBIAN LYMPHOCYTES IN VITRO AT THE G_2 PHASE UPON THE VARYING DOSES OF X RAYS. Pankova, N. V. (Inst. of Developmental Biology, Moscow). Genetika; 10: No. 5, 52-56(May 1974). (In Russian).

Amphibian lymphocytes were irradiated by various doses of x-rays: 25, 50, 75, and 100 R at the G_2 phase of the cell cycle. Frequencies of chromatid aberrations (terminal chromatid deletions and chromatid translocations) at the first post-irradiation metaphase were studied. Dose-response curves were constructed for these types of aberrations. The data were fitted by regression analysis. Chromatid translocations data gave the best fit to the quadratic model. The equation was: $Y = 40 \cdot 10^{-6} D^2$. The dose-response curve for terminal chromatid deletions was $Y = 0.5 \cdot 10^{-2} + 20 \cdot 10^{-6} D^2$, the coefficient by the quadratic component was very small and not significant in this equation. (auth)

18870 FACTOR XII AND BLOOD PLATELETS AFTER WHOLE-BODY IRRADIATION. Klir, P.; Pospisil, J.; Skala, E.; Dienstbier, Z.; Tacheci, O. (Karlova Universita, Prague (Czechoslovakia). Inst. of Biophysics and Nuclear Medicine). Strahlentherapie; 146: No. 6, 713-717(Dec 1973).

4 figs.; 15 refs. As report IAEA-968/RB/73.

In a group of 7 dogs whole-body irradiated with 400 R (^{60}Co), the following coagulation tests were examined within the time of 17 days: The activity of factor XII, the activation of factor XII in vitro by means of ellagic acid, activated partial thromboplastin time, the number of blood platelets, and the adhesiveness of blood platelets. The activity of factor XII decreased from the third day, but the ability of activation in vitro suddenly increased on the ninth day. In the same time, the activated partial thromboplastin time was shortened simultaneously with a deep decrease of the count of blood platelets and platelets adhesiveness. A hypothesis was expressed that there may occur a compensation activation of plasmatic haemocoagulation component during post-irradiation regression of platelet component. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 18675, 18840, 18848, 18855, 18895, 20549, 20556, 20557, 20559, and 20560.

18871 (AED-CONF-73-508-22) RADIATION-INDUCED ALTERATIONS IN SOME NATURAL PIGMENTS OF SOME FOOD PRODUCTS. Snauwaert, I. F. (Louvain Univ. (Belgium)). 1973. 14p. INIS.

From international colloquium: the identification of irradiated foodstuffs; Karlsruhe, Federal Republic of Germany (24 Oct 1973).

Carotenoids, myoglobin, and chlorophylls are three widespread pigment groups in foods. This communication summerizes the influence of irradiation on these pigments. The influence of radurization on the carotenoids in Belgian shrimp and salmon species is discussed. The stability of those pigments in vivo is compared to the stability of B-carotene and canthaxanthin in model systems. The radiation-induced alterations in myoglobins are also discussed. Results of studies, on the influence of the presence of oxygen and/or phosphates on the formation of MetMb are reported. It is concluded that radiopasteurization of meat may be employed without significant changes in the meat color characteristics, in contrast to heat pasteurization. The influence of radiation on chlorophylls in peas is also discussed. (INIS)

18872 (COO-1772-13) INFLUENCES OF CELLULAR SUSCEPTIBILITY TO AMPHOTERICIN B AND OF POST-IRRADIATION GROWTH CONDITIONS ON INACTIVATION OF CANDIDA ALBICANS BY ULTRAVIOLET RADIATION. Sarachek, A.; Pettriess, R. W. (Wichita State Univ., Kans. (USA)). 1973. 20p. Dep. NTIS $4.00.

Results are reported from studies on the uv inactivation of strains of Candida albicans resistant to amphotericin B and sensitive to amphotericin B. The data provide further evidence that the post-irradiation effects of temperature, lipids, and nutritional enrichment depend on the constitution of the cell membrane. (CH)

18873 (COO-1772-14) GENETICS OF CANDIDA ALBICANS: NUTRITIONAL MUTAGENESIS AND COMPARATIVE SUSCEPTIBILITY TO ULTRAVIOLET IRRADIATION. Sarachek, A. (Wichita State Univ., Kans. (USA)). 1974. Contract AT(11-1)-1772. 6p. Dep. NTIS $4.00.

18874 (ITAL-5) FOOD IRRADIATION IN THE SOVIET UNION. Ulmann, R. M.; Sparenberg, H.; de Zeeuw, D. (Instituut voor Kernphysisch Onderzoek, Amsterdam (Netherlands); Instituut voor Bewaring en Verwerking van Landbouwprodukten, Wageningen (Netherlands)). 5 Oct 1970. 14p. (In Dutch). Instituut voor Bewaring en Verwrking van Landbouwprodukten, Bornsesteeg, Wageningen, Netherlands; ITAL, Wageningen, Netherlands.

Research programs on food preservation by irradiation in the USSR are reviewed. The wholesomeness of fish preserved by irradiation is discussed. Desinfestation of insect pests on dried fruits and vegetables requires a higher radiation dose than desinfestation of wheat. Preservation of fresh fruit and vegetables was also tested. Sprout inhibition of potatoes is still in the experimental stage and a mobile radiation source has been constructed. Fresh meats are irradiated after wrapping a double-layer or triple-layer plastic foil specially designed for the purpose. Desinfestation research with respect to granary products is coupled with biochemical and other research projects, but it specifically deals with entomological affects from insects occurring in Central Asia. A good deal of attention is paid to health and safety aspects with respect to choice of sites and planning of the construction of new (commercial) food irradiation plants. Scientific gamma experiments are carried out to test the possibility of improvement of the maturation of liquors, storage life of fruit juices, and organoleptic properties of mineral water and wines. (INIS)

18875 PROPERTIES OF A UV-SENSITIVE NEUROSPORA STRAIN DEFECTIVE IN PYRIMIDINE DIMER EXCISION. Schroeder, A. L. (Washington State Univ., Pullman). Mutat. Res.; 24: No. 1, 9-16(Jul 1974).

The uv-sensitive Neurospora strain uvs-2 is known to resemble the excision-defective uvr mutants of E. coli K12 in being both excision-defective and highly uv mutable. The uvs-2 strain also resembles the uvr mutants in its ability to remain photoreactivable when held in the dark for 2 h between uv-irradiation and photoreactivating light exposure, and in its maintenance of the same spontaneous deletion rate as wild type strains. Unlike the E. coli uvr mutants, however, this strain is sensitive to ionizing radiation and shows an increase in survival when held for 2 h in distilled water before plating (liquid-holding recovery). The strain is three times more sensitive to x rays than the wild type strain. It is also sensitive to nitrosoguanidine (MNNG). Sensitivity to uv, x rays and MNNG appears to be under the control of a single gene. These properties suggest that the repair defect in the Neurospora uvs-2 mutant is different from those of the uvr mutants of E. Coli K12. (auth)

18876 INTERACTION OF NEAR UV (365 NM) AND X IRRADIATIONS ON WILD-TYPE AND REPAIR-DEFICIENT STRAINS OF ESCHERICHIA COLI K12. Physical and Biological Measurements. Tyrrell, R. M. (Argonne National Lab., IL). Int. J. Radiat. Biol.; 25: No. 4, 373-390(Apr 1974).

Colony-forming and single-strand break rejoining ability of a wild-type, polA and recA recB strain of E. coli K12 have been measured after treatment with a combination of 365 nm and radiation. Exposure to 365 nm radiation immediately before x irradiation increased the slope of the x-ray survival curves to a maximum of approximately 3.4 times that of the untreated cells. The polA strain showed 75% of this synergistic interaction, but no synergism was observed in the recA recB strain. (DNA degradation, rather than strand-rejoining (measured by the alkaline sucrose gradient technique), occurred in the wild-type and repair mutant strains after similar treatment and subsequent incubation in phosphate buffer. In full medium, a limited amount of repair did occur in both the wild-type and recA recB strains during an extended incubation period, but only degradation in the polA strain. The results were interpreted taking into account the loss of trichloracetic-acid-insoluble material from the cells (DNA degradation) during the incubation period. Although a dose of 10^6 Jm^{-2} of 365 nm radiation initially inhibits both polA (type II) and recA (type III) dependent repair of x-ray-induced single-strand breaks, only the disruption of the recA pathway (which is effectively irreversible under the set of conditions employed) ultimately affects the ability of a cell to reproduce and form a colony. The results are consistent with full medium-dependent recovery of polymerase 1 activity. (auth)

18877 RADIORECOVERY POWER OF VARIOUS YEAST RNA'S ON SCORZONERA CROWN-GALL TISSUES IRRADIATED WITH ^{60}Co γ IRRADIATION. Jonard, R.; Ravelomanana, D. (Univ., Montpellier, France). Compt. Rend., Ser. D; 278: No. 3, 389-391 (14 Jan 1974). (In French).

RNA's isolated from yeast cells during the exponential growth phase are active radiorecovery agents. In contrast, those obtained from cells in the stationary phase do not exhibit any such properties. The radiorecovery power of the total yeast RNA appears to be related to the metabolic activities of the cells forming it. (FR)

18878 ACCURATE REPAIR OF ULTRAVIOLET-INDUCED DAMAGE IN MICROCOCCUS RADIODURANS. Sweet, D. M.; Moseley, B. E. B. (Univ. of Edinburgh). Mutat. Res.; 23: No. 3, 311-318(Jun 1974).

UV-induced mutation in the very radiation-resistant bacterium Micrococcus radiodurans was investigated. Forward mutation of

the wild type to resistance to trimethoprim and reversion of a temperature-sensitive mutant were studied. Both the wild type and the temperature-sensitive mutant were found to be non-mutable by uv-radiation, but were sensitive to mutation by N-methyl-N'-nitro-N-nitrosoguanidine (NTG). The wild type was also resistant to mutation by 4-nitroquinoline-N-oxide (4NQO). Neither strain was sensitized to uv-induced mutation by exposure to caffeine after irradiation. It is concluded that, unlike other bacteria in which high resistance to uv-induced killing is associated with sensitivity to uv-induced mutation, repair of uv-induced damage in M. radiodurans is accurate. (auth)

18879 EFFECT OF γ IRRADIATION ON THE RESPIRATION OF UNICELLULAR ALGAE. Ehrhardt, J. P. (Centre de Recherches su Sercice de Sante des Armees, Clamart, France). Compt. Rend. Soc. Biol.; 167: No. 11, 1529-1531(1973). (In French).

It was established that irradiated cultures consume more oxygen during the first few hours following γ irradiation than nonirradiated reference cultures. In the long term, however, γ radiation reduces the amplitude of respiration. Measurements made of the volume of oxygen consumed by irradiated algae demonstrated that less oxygen is consumed by these algae than by non-irradiated reference cultures. The reduction in respiration, which follows the immediate stimulation occurring after irradiation, can be considered to be due to the nonrepaired destruction of certain mitochondrial structures. (FR)

18880 REPLICATION AND REPAIR OF UV-INDUCED MUTATIONAL LESIONS IN CHEMOSTAT CULTURES OF ESCHERICHIA COLI WP2 HCR. Kubitschek, H. E. (Argonne National Lab., IL). Mutat. Res.; 23: No. 3, 297-309(8 Apr 1973).

Mutation to resistance to bacteriophage T_5 was studied in chemostat cultures of Escherichia coli strain WP2 Hcr exposed to ultraviolet radiation (uv). The results are in generally good agreement with those obtained earlier by Bridges and Munson for uv-induced reversion to tryptophan independence in exponentially growing cultures of the same strain: expressed mutant yields followed a dose-squared response, mutations were not expressed before approximately one generation after exposure to uv, there was a slow disappearance of dimers especially noticeable in slowly growing and stationary cultures, and the first replication gave rise to duplex mutants in both strands. Several new results were also obtained. In addition to expressed mutant yields, induction of mutational capacity was also observed to follow a dose-squared response, indicating that the response is not an artifact of selection or repair. Induction also increased with growth rate, apparently as the square of the number of genes for T5-sensitivity per cell. It is suggested that mutagenesis is proportional to the number of genes per cell, that recombination is also proportional to the number of genes per cell, and that the number of mutational lesions is proportional to the product of the two. These results also provide evidence that DNA replication occurs near the end of the cell cycle in slowly growing cultures. Under all growth conditions, latent mutant concentrations (mutational capacity) decreased by a factor of two with each successive division. Latent mutants were, however, photoreversible for only the first two generations. If mutagenesis occurs as a recombinational event between two mutational lesions, then the results also indicate that these lesions are separated, on the average, by no more than a single cistron. (auth)

18881 NUTRITIONAL HYGIENE ASPECTS OF RADIOPRESERVATION OF FOOD. Uralova, M.; Grunt, J. (Research Inst. of Hygiene, Bratislava). Cesk. Hyg.; 18: No. 3, 119-126(Apr 1973). (In Slovak).

The determination of the optimum regimen of irradiation for the preservation of vitamin E during the use of ionizing radiation for pasteurization and sterilization of food is very important from the point of view of nutrition. Various experimental examinations confirmed the destructive effect of ionizing radiation (γ rays) on vitamin E. The radioresistance of vitamin E is dependent on the concentration of the preparation in a solution. Increasing the dose of ionizing radiation was found to result in an increasing percentage of destruction; the radiation dose rate also proved to be important. The presented study into the effect of storage time on the content of vitamin E in irradiated food samples revealed that radiolytic processes were going on not only during the actual irradiation time but a long time after irradiation. (Nuclear Sci. Abstr. Czech.)

18882 INACTIVATION OF BACTERIAL SPORES BY CHARGED PARTICLES. Yatagai, F.; Takahashi, T.; Kitajima, Y.; Matsuyama, A. (Inst. of Physical and Chemical Research, Wako, Japan). J. Radiat. Res.; 15: No. 2, 90-95(Jun 1974).

Bacillus subtilis spores were bombarded with α particles and heavy ions of carbon, nitrogen, and oxygen accelerated in the IPCR cyclotron. The maximum RBE was found at an unrestricted LET of about 120 keV·μm^{-1}. The effective inactivation cross section, S_{eff}, for α particles increased with LET, reaching a stationary level of S_α^{st}, 0.145 μ^2. The analysis of the LET dependence revealed that several primary activations are required for producing one lethal-hit, within a very short length of the particle track. The value of S_α^{st} was lower than S_{eff} for heavy ions (0.22 to 0.26 μm^2). This discrepancy may be due to a difference of the repair capacities of "strand-target" between α-particles and heavy-ion bombardments, or to existence of a target(s) that is sensitive for bombarding particles of extremely high LET, or to long-range effects caused by such high-LET particles. (auth)

18883 ACTIVATION OF DNA LIGASE IN CELLS OF BAC. SUBTILIS IRRADIATED WITH IONIZING RADIATION. Gaziev, A. I.; Zakrzhevskaya, D. T.; Sergeeva, S. A.; Fomenko, L. A.; Kuzin, A. M. (Inst. of Biological Physics, Pushchino, USSR). Dokl. Biochem. (Engl. Transl.); 213: No. 1-6, 596-598(1973).

Translated from Dokl. Akad. Nauk SSR; 213: No. 6, 1435-1438 (Dec 1973).

The investigation of the postradiation state of the DNA-repairing enzymes in the irradiated cell is of substantial interest for an understanding of the processes of repair and reconstruction of damaged DNA. Results are reported from studies on the changes in the DNA ligase activity in γ-irradiated cells of Bacillus subtilis during their postradiation incubation. (CH)

18884 STERILIZATION OF FOODSTUFFS BY IRRADIATION. Diehl, J. F. (Inst. fuer Strahlentechnologie, Karlsruhe, Ger.). Zentralbl. Bakteriol., Parasitenk., Infektionsk. Hyg.; 156: No. 2/3, 157-170(1972). (In German).

Progress in the radiopreservation of food in the Federal Republic are reviewed. The possibilities of radurization and radiation disinfestation of food are discussed, with special attention to microbiological aspects, referring particularly to Clostridia and Salmonellae. Definition of the terms are included and the methods of application with regard to various foodstuffs such as meat, fish, fruits, vegetables, and spices, and irradiation methods for the purpose of sterilizing army rations and food for certain patients in clinics are described. The combined treatment of some foodstuffs by means of irradiation and low temperatures or irradiation and heating offers the possibility of reducing the radiation dose. Problems arising from the occurrence of organoleptic changes during and after irradiation, and aspects of legislation on irradiated food, especially with regard to the situation in the German Federal Republic, are discussed. (GE)

18885 RADIOSTERILIZATION OF MEDICAL AND PHARMACEUTICAL PRODUCTS. Schwenker, G. (Univ., Karlsruhe, Ger.). Zentralbl. Bakteriol., Parasitenk., Infektionsk. Hyg.; 156: No. 2/3, 171-180(1972). (In German).

Sterility is required for all technical instruments and pharmaceutical products. The only alternative to the usually expensive method of sterilization at one of the stages of production is sterilization by irradiation, particularly with γ rays of great penetration. The application of this method depends on an accurate knowledge of the microbiology on which the sterilization process is based and the stability of the irradiated product under the influence of the required irradiated dose. Although the results of a great number of fundamental investigations into radiobiology are available and the necessary radiation doses and the required microbiological precautions are known, renewed and comprehensive tests have to be made in each new case to determine the stability of the product during and after irradiation. The necessity for such extensive research, coupled with the fact that in many countries, including the German Federal Republic, there is restrictive legislation intended to protect the public from unnecessary risks in the treatment of disease, has restricted the application of this method of sterilization mainly to medical devices and a number of surgical accessories. Drugs, in the strict sense of the word, are still entirely absent from the list of commercially irradiated products. (GE)

18886 GENETIC CONTROL OF RADIORESISTANCE IN ESCHERICHIA COLI $B_{S-1\gamma}R$. Nesterova, G. F.; Zhestyanikov, V. D. (Inst. of Cytology, Leningrad). Genetika; 10: No. 5, 99-105(May 1974). (In Russian).

Genetic determination of resistance to gamma-irradiation and methylmethane sulphonate in Escherichia coli $B_{S-1\gamma}R$ was investigated by transduction using P1bt and $P1_{vir}$ phages. The resistance to these agents which is similar to those of B/r strain, and peculiar to $B_{S-1\gamma}R$ sensitivity to uv-light, mitomycin C and nitrogen mustard cotransduce to the recipient $B_{S-1\gamma}$ with the locus Azi. The sensitivity of $B_{S-1\gamma}$ to the irradiations and chemical mutagens cotransduces with Azi. The mutation of gamma-resistance in $B_{S-1\gamma}R$ influences on filament formation like mutation sul in E. coli B/r but it differs from the known mutation sul by closer linkage with Azi, smaller effect on filament formation and pleiotropy which results in the decrease of viability of the bacterial cell. The increase

of resistance to methylmethane sulphonate and the decrease of filament forming capacity in strains having this mutation and lon mutation points out that corresponding allele (like sul) inhibits the manifestation of lon mutation which may be due to another location within Sul locus. This mutation may also be localized within another locus, closely linked with Azl locus. (auth)

18887 ABSTRACTS OF THE ANNUAL MEETING OF THE AMERICAN SOCIETY FOR MICROBIOLOGY, MIAMI BEACH, FLORIDA, MAY 6–11, 1973. Washington, DC; American Society for Microbiology (1973). 319p. (CONF-730534–(Absts.)). $10.00.

Abstracts are included for 1,432 papers presented covering environmental and applied microbiology; medical microbiology and immunology, including mycology; microbal physiology; and virology. (CH)

18888 PRIMARY UV LESIONS FOR REVERSION TO PROTOTROPHY IN AUXOTROPHIC ESCHERICHIA COLI. Inferences from Studies of Protection by Acriflavine. Alper, T.; Forage, A. J. (Medical Research Council, London (UK). Experimental Radiopathology Unit). Mol. Gen. Genet.; 128: No. 2, 47-155(Jan 1974).

6 figs.; 18 refs.

Acriflavine bound to DNA inhibits pyrimidine dimerization by uv and its protective effect has been studied as a method of inferring the role of pyrimidine dimers as premutational lesions for reversion to prototrophy in dimer-excising and non-excising variants of a tryptophan auxotroph. With the non-excising strain, in which induced suppressor mutations are not subject to mutation frequency decline ("mfd"), protection against mutation induction was greater than against killing. With the excising strain, protection against mutation induction was equal to that exerted against killing, provided the overwhelming majority of revertants were suppressors; so it was inferred that the premutational lesions were dimers. When scoring was on minimal medium with added tryptophan so that mfd occurred, there was much less protection against mutation induction. Like previous results, this suggested that the relatively small number of revertants scored on tryptophan-supplemented minimal agar resulted from primary photoproducts other than those from which the majority scored on broth-supplemented plates originated. (auth)

Radiation Effects on Plants

Refer also to abstracts 18841 and 18842.

18889 SENSITIVITY OF THE HEXAPLOID FORM OF WHEAT TO GAMMA RADIATION. Sadykhov, A. Dokl. Akad. Nauk Azerb. SSR; 29: No. 11-12, 82-84(1973). (In Russian).

Five varieties of wheat were subjected to γ doses of 5, 10, 15, 20, and 25 Ci to determine the radiation effects on the germination, spike size, number of spikes, spike weight, and plant height. The results are shown graphically. (JSR)

18890 EFFECT OF ETHYLENIMINE AND IRRADIATION BY ^{60}Co ON THE GROWTH, YIELD, AND CAPSAICIN CONTENT OF PEPPER (CAPSICUM ANNUM L.). I. Zderkiewicz, T. (Akademia Rolnicza, Lublin, Poland). Acta Agrobot.; 24: 343-356(1971). (In Polish).

Application of mutagenic factors (EI in concentrations: 0.03%, 0.06%, 0.125%, 0.25%, and doses of ^{60}Co rays: 5000 R, 10 000 R, 15 000 R, 20 000 R) were used. Ethylenimine and irradiation had a positive effect on the capsaicin content in fruits of pepper. Difference in the growth of plant and size and weight of fruits were observed. (auth)

18891 USE OF IONIZING RADIATIONS TO IMPROVE HARICOT BEANS (PHASEOLUS VULGARIS L.). Sarafi, A. (Teheran Univ., Iran). Ann. Amelior. Plant.; 23: No. 1, 77-81(1973). (In French).

Between 1967 and 1970, various studies were effected on 4 varieties of γ- and neutron-irradiated haricot bean. The research conducted led to the obtaining of a mutant, M_3, having a greater yield than that of the reference plants. In 1971, comparisons were made between 6 mutants of the two most productive varieties and reference plants, protein levels and grain sizes being adopted as criteria. Some of the plants presented protein levels greater than those of the reference plant and others lower levels; the grains were larger than those of the reference plants; the best mutants had grains 12.8% larger and 14.8% more protein rich than the reference variety; a positive and significant correlation ($r = 0.703$) exists between the % protein and the size of the mutant grains. (FR)

18892 RADIORESISTANCE TO ^{60}Co γ RADIATION INDUCED IN RICE SEEDS (ORYZA SATIVA L.) BY PRIOR INHIBITION AT LOW TEMPERATURES. Bayonove, J. N.; Marie, R.; Marien, J.; Soler, A. (Montpellier Univ., France). Compt. Rend., Ser. D; 278: No. 8, 1115-1118(18 Feb 1974). (In French).

The sensitivity of rice seeds to ^{60}Co γ radiation was reduced by allowing them to imbibe water at 5°C and then dehydrating them at 32°C. The heat treatment of dry caryopses did not affect their radiosensitivity. (FR)

18893 CHLOROPHYLL-DEFICIENT MUTATION FREQUENCY IN BARLEY FOLLOWING CONTINUOUS GAMMA IRRADIATION OVER A WIDE RANGE OF EXPOSURES THROUGHOUT THE LIFE CYCLE. Conger, B. V.; Constantin, M. J.; Bottino, P. J. (UT-AEC Comparative Animal Research Lab., Oak Ridge, TN). Mutat. Res.; 23: No. 3, 327-335(Jun 1974).

An experiment was conducted to test the influence of continuous γ-irradiation over a wide range of exposures throughout one life cycle on inducing chlorophyll-deficient mutations in barley (Hordeum vulgare). 200 seeds per treatment were planted at various distances from the radiation source. Treatments ranged from 0.17 R/day (16.5 R total exposure) to 23.2 R/day (2240 R total exposure). The plants were exposed 20 h per day from time of emergence until harvest (96 days) and the apical spikes harvested from each surviving plant. 20 seeds (at random) from each spike were removed and bulked with those from other spikes within the same treatment to make up the M_1 population. Seeds from non-irradiated plants were also included as a treatment. Up to 5 spikes were harvested from each M_1 plant, planted in greenhouse benches, and M_2 seedlings scored for chlorophyll-deficient mutants. M_1 plant survival and reduction in seed set were approximately the same regardless of the treatment. The frequency of mutations per 10,000 M_2 seedlings increased from 1.3 for the non-irradiated population to 4.3 for progeny of plants receiving 0.17 R/day. This frequency remained about the same through 1.45 R/day. At 3.17 R/day, the frequency increased to 7.0 and was 45.4 at 23.2 R/day. Although there appears to be a plateau at the low exposures, it is not possible to determine the exact shape of the dose response curve. A mathematical model with an equation of the form $Y = Be^{CX^2}$ and also a linear-linear model were used to summarize the data. The mutation spectrum from all treatments was 70.6% albina, 17.6% viridis and 11.7% others. (auth)

18894 MODIFICATION OF GENETIC DAMAGE BY POST-TREATMENT WITH CAFFEINE APPLIED DURING OXYGENATED AND OXYGEN-FREE HYDRATION IN HORDEUM VULGARE. Kesavan, P. C.; Ahmad, A. (Jawaharlal Nehru Univ., Delhi). Mutat. Res.; 23: No. 3, 337-346(Jun 1974).

Oxygen-free hydration affords maximal protection against the post-irradiation oxygen-dependent (Class III) damage assessed as M_1 seedling injury, chromosomal aberrations, and M_2 chlorophyll mutations. Heat shock and caffeine also eliminate part of this damage. When heat shock and caffeine are successively applied, the level of protection afforded by anoxic hydration is significantly reduced. Caffeine applied during anoxic hydration reduces the seedling injury to a much greater extent than it reduces the frequency of chlorophyll mutations. The role of heat shock, under these conditions, is almost to reverse the ratio of seedling injury to chlorophyll mutations. The probable mechanism of action of caffeine as well as the implications of differential modification of the seedling injury and genetic damage are briefly discussed. (auth)

18895 EFFECT OF CHRONIC γ-IRRADIATION ON THE WILD LIFE AND MICROPLANT LIFE OF A WOODED ECOSYSTEM AT CADARACHE. Bigot, L.; Grauby, A.; Poinsot, N.; Rougon, G.; Tchernia, F. (CECN de Cadarache, Saint-Paul-les-Durance, France). Radioprotection; 8: No. 4, 243-256(1973). (In French).

Chronic gamma-irradiation of a forest ecosystem resulted in a significant action on living organisms, as far as entomofauna or microflora are concerned. A demographic explosion of Psoques was observed three years later, as well as a disappearance of Collembola in the nearest zone of the irradiator and a reduction of the soil activity. (FR)

18896 UV-RADIATION-INDUCED INCORPORATION OF THYMINE AND THYMIDINE INTO THE DNA OF BLUE–GREEN ALGAE. Shestakov, S. V.; Glazer, V. M.; Zhevner, V. D. Biol. Nauki; No. 5, 107-111(May 1973). (In Russian).

In actively dividing cells of the blue–green algae, Anacystis nidulans and Synechocystis aquatilis, thymidine-2 ^{14}C was slightly incorporated into the DNA. Replication of the DNA was judged by inclusion of the radioactive label of the uracil-2 ^{14}C in the A. nidulans DNA and of the uracil-2 ^{14}C or of thymine-2 ^{14}C in the S. aquatilis DNA. The uv radiation partially inhibited the inclusion of the labeled uracil but stimulated that of thymine and thymidine in the DNA of both species. Labeled thymine and thymidine were included most efficiently in DNA upon incubation of the uv-irradiated cells under conditions in which photoreactivation and stimulating reparative synthesis were excluded. It is thought that the differentiated use of uracil, thymine, and thymidine in uv-irradiated

and nonirradiated cells is related to the presence in the blue–green algae of different amounts of DNA precursors. (tr-auth)

18897 ELECTRON IRRADIATION APPLICATION FOR STIMULATION AND INHIBITION OF POTATO GERMINATION. Komar, E. G.; Khomyakov, A. M.; Lysov, A. V.; Zheleznikov, F. G.; Lipsits, D. V.; Serebranikov, V. S.; Anisimov, B. V.; Parfenov, V. T. pp 82–87 of Primenenie Izotopov i Yadernykh Izluchenii v Sel'skom Khozyaistve. I. Moscow; Atomizdat (1971). (In Russian).

The effect of electron irradiation on the potato tuber was studied. The problem was to establish the optimum radiobiological effect on the surface of the tuber with eye buds not affecting the deep-lying layers. For this purpose fast electron beams in the energy range from 0.5 to 3.5 MeV with beam currents up to 100 μamp were used. The influence on the radiobiological effect of different doses and levels of electron beam energy and dose rate was studied. Tables are given in which the effect of electron irradiation (75 rad) on the germination and productivity of the potatoes is reported. The promising future of the use of electron irradiation for growth stimulation and sprout inhibition during storage of potatoes is discussed. (tr-auth)

18898 APPLICATION OF γ AND ELECTRON IRRADIATION OF TUBERS TO INCREASE THE PRODUCTIVITY AND STORAGE LIFE OF POTATOES. Serebrenikov, V. S.; Parfenov, V. T.; Anisimov, B. V.; Lipsits, D. V. pp 88 of Primenenie Izotopov i Yadernykh Izluchenii v Sel'skom Khozyaistve. I. Moscow; Atomizdat (1971). (In Russian).

The effect of the dose rate, cultivation conditions, and the strain characteristics of potatoes on the effectiveness of the use of γ and electron irradiation of tubers for improvement of the productivity and prolongation of the storage time for potatoes were studied. It was established that with the maintenance of a regular irradiation regime, a correct selection of the dose for different strains, consideration of the cultivation conditions and the pre-sowing γ irradiation guarantees a stable increase of the crop. The tests showed that electron irradiation at doses of 20 krad inhibited the germination of potatoes and promoted the storage life of the tuber. (tr-auth)

18899 EFFECTS OF ^{60}Co γ RADIATION ON FERTILITY IN SUNFLOWERS FOLLOWING ACUTE IRRADIATION OF VEGETATIVE PLANTS. Savin, V. N.; Stepenenko, O. G. pp 45–50 of Primenenie Izotopov i Yadernykh Izluchenii v Sel'skom Khozyaistve. I. Moscow; Atomizdat (1971). (In Russian).

Tests were made on the effects of acute irradiation on vegetative sunflowers. The sunflowers of two varieties (Giant-549 and Peredovik) with a base of 8 to 10 leaves were irradiated with ^{60}Co γ radiation. During the growth process changes of the length of the main stem and diameter of the calathide were observed. The leaf area and thickness was altered. The concentration of dry material, chlorophyl, and carbon in the leaves were determined. Phenological observation was made. At the conclusion of the tests the yield that indicated the decrease in the number of seeds in the sunflower calathide irradiated at a dose of 1 kR was determined. At the same time the weight of one thousand seeds of a plant irradiated at a dose of 1 kR exceeded that of the control. (tr-auth)

18900 RADIORESISTANCE OF HIGHER PLANTS AND PHYLOGENETIC RELATIONS. Preobrazhenskaya, E. I. pp 52–58 of Primenenie izotopov i Yadernykh Izluchenii v Sel'Skom Khozyaistve. I. Moscow; Atomizdat (1971). (In Russian).

A comparative method was selected for study of the radioresistance of plants. The comparison was made both between systematically separated groups of plants (phyllum, class, order, family) and between related forms (species, varieties, and strains). Air-dried seeds of all species and strains were irradiated with different doses of ^{60}Co γ radiation from 0.5 to 300 kR. The dose rate varied from 600 to 1000 R/min. All irradiated species were divided according to the degree of their radioresistance into three groups. The lethal doses, shown by the survival of plants at the end of the vegetation period, were taken as the boundary of each group: for the radiosensitive group from 15 to 20 kR, for the average group from 25 to 100 kR, and for the radioresistant group from 100 up to 200 or 300 kR. (tr-auth)

18901 INFLUENCE OF THE STAGE OF THE CELL CYCLE AND TIME OF FIXATION ON THE FREQUENCY OF CHROMOSOME ABERRATIONS INDUCED BY IRRADIATION. Luchnik, N. V.; Morozov, K. N.; Fesenko, E. V.; Lychev, V. A. (Scientific-Research Inst. of Medical Radiology, Obninsk, USSR). Dokl. Biol. Sci.; 212: No. 1-6, 410-412(1973).

Translated from Dokl. Akad. Nauk SSSR; 212: No. 5, 1220-1223 (Oct 1973).

In experiments on the induction of chromosome aberrations, with variation of the stage of the cell cycle at which the influence of the mutagen occurs, the time interval between the influence of the mutagen and fixation also changes. Therefore, the observed differences in the quantitative yield of aberrations are attributed by different authors either to different sensitivity of the different stages of the cycle or to a different degree of postradiation influence. The influence of these two factors can be separated with the aid of a radioactive label. Crepis capillaris seeds were germinated for 30 h on moist filter paper. A pulsed label with ^{3}H-thymidine (concentration 7 μCi/ml, specific activity 4.2 Ci/mmole) was supplied for 20 min; during the following 20 min the unincorporated thymidine was washed out with flowing water, and the sprouts irradiated with γ rays of ^{60}Co at a dose of 400 rad and a dose rate of 20 rad/min. At various times after irradiation the seedlings were placed for 2 h in a 0.01% solution of colchicine and fixed in Carnoy's mixture. The metaphases were investigated for the presence and nature of chromosome aberrations on specimens stained with acetocarmine, noting the coordinates of the aberrations on the specimen and drawing them schematically. Then the specimens were covered with a photographic emulsion, exposed for a week, and the presence of the label in the analyzed cells determined. As a result, most of the cells irradiated at the stage of synthesis contained a label, whereas most of the cells irradiated outside this stage were unlabeled. (CH)

18902 RADIOSENSITIVITY OF SEEDS. Pesina, K. (Inst. of Experimental Botany, Prague); Srb, V. (Inst. of Experimental Botany, Prague). Geofiz. Sb.; 38: No. 1, 54-66(1973). (In Czech).

The radiosensitivity of seeds is reviewed with respect to intrinsic factors acting in the seed. From the systems point of view, radiosensitivity of a species is primarily determined by the volume of the nucleus. Differences in sensitivity in lower taxons seem to be dependent mainly on genetic factors of a polygenic character. The actual mechanism of radiation injury is determined by interaction of free radicals formed and oxygen controlled by water molecules. For a given dose, radiation damage may vary according to the amount of water available for chemical reactions. The biological injury of seeds does not represent a simple physicochemical process. Its individual components may either be interrelated or independent. The degree of biological injury by ionizing radiation seems to be time dependent. Barley seeds were used in most experimental efforts. Even though the general validity of the results was confirmed by experiments using other species, differences can nevertheless be expected for seeds having a different germination physiology. (Nuclear Sci. Abstr. Czech.)

18903 MUTABILITY OF VEGETABLE PEA AND TOMATO INDUCED BY CHRONIC IRRADIATION OF PLANTS AND ACUTE IRRADIATION OF SEEDS WITH GAMMA RAYS. Dolgikh, S. T.; Khafizov, R. N. (Research Inst. of Vegetable Crops, Moscow). Genetika; 10: No. 5, 23-26(May 1974). (In Russian).

Results of the investigations on variations in peas and tomatoes induced by gamma-rays showed that at irradiation doses used the mutability of plants in case of chronic irradiation was higher than in case of acute irradiation of seeds. The mutability of peas and tomatoes in some cases of irradiation at different stages of organogenesis was higher than in case of gamma irradiation throughout the vegetative period. (auth)

18904 EXPERIMENTAL MUTAGENESIS IN APPLE TREE. IV. Phenotypic and Genotypic Effects Induced in Malus Domestica by Small Doses of X Rays and Nitrosomethylurea. Kolontaev, V. M. (State Pedagogical Inst., Tambov, USSR). Genetika; 10: No. 5, 27-34(May 1974). (In Russian).

Separate and combined treatment with x-rays and nitrosomethylurea at low doses was observed to induce in Malus domestica similar mutations differing from one another in winter-hardiness and in the frequency of chromosome rearrangements. Combined treatment with these mutagens proved to be more efficient than separate treatment. (auth)

Radiation Effects on Animals

Refer also to abstracts 20550, 20564, and 20568.

18905 (RL-74-38, Paper 7) INFLUENCE OF RADIATION QUALITY UPON ITS BIOLOGICAL EFFECTS. Berry, R. J. (Churchill Hospital, Oxford). 1973.

From school for young high energy physicists; Chilton, UK (15 Jul 1973).

The subject is discussed under the following headings: effects of x or γ radiation on body tissues, the measurement of cell reproductive capacity; effects of other radiations, (relative biological effectiveness, linear energy transfer, oxygen enhancement ratio); and developments in applications of fast neutrons and negative pi-mesons for radiotherapy. (UK)

Man

Refer also to abstracts 18363, 18614, 18615, 18618, 18628, 18652, 18735, 18863, 19026, 20531, and 20545.

18906 (AED-CONF-73-570-9) EXAMINATION TECHNIQUE AND SUPERVISION OF PATIENTS IN ENDOLYMPHATIC RADIONUCLIDE THERAPY. Peters, P. E. (Deutsche Klinik fuer Diagnostik, Wiesbaden (F. R. Germany). Sektion Radiologie; Muenster Univ. (F. R. Germany). Radiologische Klinik). 1973. 12p. (In German). INIS.

From 10th DKD-workshop together with the International Society of Lymphology; Wiesbaden, Federal Republic of Germany (1 Dec 1973).

Measures deviating from the common techniques are described, which have to be taken into consideration during endolymphatic radionuclide therapy. The main objectives are the preliminary examination of the patients, radiation protection methods, modifications in diagnostic techniques, supervision of patients during the injection, and care during treatment. (INIS)

18907 (BNWL-B-264) KRONIC: A COMPUTER PROGRAM FOR CALCULATING ANNUAL AVERAGE EXTERNAL DOSES FROM CHRONIC ATMOSPHERIC RELEASES OF RADIONUCLIDES. Strenge, D. L.; Watson, E. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jun 1973. Contract AT(45-1)-1830. 155p. Dep. NTIS $10.75.

Mathematical models and a computer program KRONIC are described for calculation of annual average β and γ doses to man resulting from chronic release of radionuclides to the atmosphere. The dose calculations are performed for each sector about the release point and use joint frequency of occurrence data for atmospheric stability and wind speed. A complete program listing is provided together with input instructions and sample problems. (auth)

18908 (CONF-740702-3) UNIFORM POSITIONING AND COLLIMATION IN ROUTINE ABDOMINAL X-RAY DIAGNOSIS. Gileadi, M. (Puerto Rico Nuclear Center, Mayaguez). 1974. 19p. Dep. NTIS $4.00.

From Health Physics Society annual meeting; Houston, Texas, USA (7 Jul 1974).

While gonadal dose measurements form the experimental basis for evaluation of potential genetic hazards associated with diagnostic radiography, a survey of the current literature indicates that parallel data measured and reported by various investigators differ sometimes by as much as a factor of 10 to 50 between highest and lowest published values for the same routine diagnostic examination. Dose differences are especially marked in some of the so-called genetically hazardous x-ray examinations, such as pelvis, lumbar spine, and hip. In order to investigate the reasons for such discrepancies, a series of measurements were performed using TLD-LiF dosimeters on male patients scheduled for a selected group of routine abdominal x-ray examinations in several medical facilities in Puerto Rico, following the radiological techniques customary in each facility. Presented results obtained to date from these measurements point out the significance of positioning and proper collimation with respect to the testicular dose incurred in a given routine abdominal examination. (auth)

18909 (SZS-148, pp 68-80) MAXIMUM PERMISSIBLE CONCENTRATIONS OF NATURAL RADIOACTIVE MATERIALS (THORIUM, URANIUM) IN ORE, CONCENTRATE, AND MILLING DUSTS OF RARE METALS. Elovrkaya, L. T.; Kapitanov, Yu. T.; Lyarskii, P. P.; Likhachev, Yu. P. Mar 1973. (In Russian).

From German-Soviet working meeting on the question of radiation protection; Berlin, Germany (8 June 1972).

Problems of radiation protection arising in the production of rare metals are caused by the economically insignificant content of Th and U in the ore. The significance of the thorium content in industrial dusts is evaluated with regard to radiation protection. With experimentally produced pneumoconiosis an intensification of the pathogenic effects of dusts was observed after a single intratracheal application to as well as a chronic aerosol exposure of 2000 virginal albino rats if the dose absorbed in the lungs was between 150 and 200 rem. It is concluded that in handling materials with activity concentrations less than 5.10^{-10} Ci/g no additional radiation protection requirements are necessary if common industrial hygienic norms for permissible dust concentrations are observed. The problem of late effects after chronic exposure to dust with increased activity concentrations must be regarded as unsolved. (auth)

18910 (SZS-148, pp 81-86) LINES OF EXPERIMENTAL RESEARCH IN ESTABLISHING MATHEMATICAL MODELS FOR THE EVALUATION OF INTERNAL EXPOSURE. Bad'in, V. I.; Ermilov, A. P.; Margulis, U. Ya.; Khrushch, V. T. Mar 1973. (In Russian).

From German-Soviet working meeting on the question of radiation protection; Berlin, Germany (8 June 1972).

Lines of research necessary for the statistical treatment of a model of internal exposure are described. The radionuclide content of an organ must be considered as a random function. In the mean it is probable that the ratio of two independent incorporations corresponds to the ratio of the amounts of the radionuclide accumulated in the organism. This is given by the principle of similarity. With repeated experiments a log-normal distribution in the organism is obtained. For setting-up a quantitative statistical metabolism model a large number of experimental data is needed. This requires the completion of the existing rapid methods. (auth)

18911 (SZS-148, pp 88-95) DETERMINATION OF DEOXYRIBOSIDES IN URINE AND BLOOD WITH REGARD TO APPLICATION IN BIOLOGICAL DOSIMETRY. Solle, M.; Orban, U. Mar 1973. (In German).

From German-Soviet working meeting on the question of radiation protection; Berlin, Germany (8 June 1972).

Data are presented on the determination of deoxyribosides in blood and urine of rat and man and on the corresponding normal values. On the basis of results obtained in animal experiments the possibility of applying deoxyriboside determination to the detection of radiation injuries is discussed. (auth)

18912 (SZS-148, pp 124-129) ENVIRONMENTAL MONITORING. Marei, A. N. Mar 1973. (In Russian).

From German-Soviet working meeting on the question of radiation protection; Berlin, Germany (8 June 1972).

Principles established in the USSR for monitoring the radioactivity of the biosphere are presented. The fulfillment of legal requirements is achieved by pre-operational and routine monitoring. Pre-operational monitoring is performed in the design and construction stage of potential contamination sources (nuclear plants etc.) whereas routine monitoring is essential during operation. The programme for routine monitoring depends on the local conditions. Fallout monitoring requires a net of monitoring stations which renders possible the assessment of environmental contamination as well as of the radiation exposure of the population. The significance of factors causing or limiting the exposure of the population is evaluated. The main task of monitoring environmental contamination caused by radioactive wastes exists in limiting the uptake of radioactive substances by the critical population group to a minimum. Another task is the evaluation of the radiation situation as a whole. Type and extent of operation are determined by the local character of contamination, the size of the source, type and amount of the wastes to be disposed of, physical properties of the environment, the way in which it is used by man and the characteristics of the exposed population. The critical nuclides and the critical population group are of primary concern. In the USSR environmental monitoring is performed by various authorities. Responsibility for all aspects of radiation protection, however, rests with the public health authorities charged with the control of radiation hazards. (auth)

18913 (SZS-155) PROBLEMS OF RADIATION PROTECTION IN DENTAL X-RAY DIAGNOSTICS. Taschner, P.; Koenig, W.; Menzel, B. (Staatliche Zentrale fuer Strahlenschutz, Berlin (German Democratic Republic)). Mar 1974. 24p. (In German). Dep. NTIS (US Sales Only) $4.25.

Results of radiation monitoring measurements performed at dental x-ray units in the German Democratic Republic are presented. The influence of operational parameters on dose rate or dose are discussed. From the results, conclusions are drawn considering the duties of the technician. Radiation protection standards now in force are explained with regard to diagnostic dental radiography. (auth)

18914 FREQUENCY AND IMPORTANCE OF LATE INTESTINAL REACTIONS AFTER CURATIVE RADIATION THERAPY IN FEMALE PATIENTS WITH COLLUM CARCINOMA AND MALE PATIENTS WITH TESTICLE TUMORS. Prager, W.; Taubert, W. (Karl-Marx-Univ., Leipzig). Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 83-87(1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

Late intestinal reactions were detected in patients following abdominal exposure during radiotherapy. Pathological changes were observed in 28.2% of patients with uterine carcinoma and in 30% of the patients with testicle tumors. In a comparison of the quota for conventional deep x-ray therapy and ^{60}Co γ pendulum irradiation at doses up to 5500 Rad only slight variations could be detected. (tr-auth)

18915 EARLY REACTIONS OF THE GASTROINTESTINAL TRACT AFTER IRRADIATION OF THE ABDOMEN IN TUMOR PATIENTS. Neumeister, K.; Kamprad, F. (Karl-Marx-Univ., Leipzig). Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 79-82(1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

The frequency of occurrence of intestinal disturbances and the weight loss of patients during radiation therapy was studied

in 293 patients irradiated in different ways because of different types of tumors in the area of the abdominal cavity. The fraction of patients with diarrhea was highest following irradiation of the rectum and the jejunum. Patients with clinically evident intestinal disturbances had an average weight loss of 3.8%. On the other hand patients without diarrhea lost only 1.4% body weight. In addition to changes in water loss and catabolic metabolic processes, a radioinduced resorption disturbance of the small intestine is discussed as the origin of the weight loss. (tr-auth)

18916 GASTROINTESTINAL CHANGES IN THE TELEGAMMA THERAPY OF TUMORS IN THE ABDOMINAL REGION. Glaser, F. H.; Beutler, W.; Klaus, M.; Kraft, M.; Salewski, D. (Martin Luther Univ., Halle, Ger.). Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 73-78(1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

From 1968 to 1972 a total of 407 patients with gynecological tumors received external γ radiotherapy with doses totaling 6000 to 8000 R delivered to the abdomen in fractions of 1000 to 1500 R. The radioinduced changes in the intestine were followed in these patients as a function of radiation dose and time of appearance. (tr-auth)

18917 RADIATION TOLERANCE OF THE RECTUM. Groszmann, H. Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 99-101(1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

By 123 parallel measurements of radiation dose to the rectum of patients during radiotherapy with two radiation dosemeters of different measurement geometry it was shown that variations by the factor two can occur. Therefore, in individual patients a comparison of radiation dose distributions made with different dosemeters is not possible. Statements on any radiation tolerance in the area of a steep dose drop are usable only with consideration of all parameters, including the measurement geometry and the response of the instrument. (tr-auth)

18918 THERAPEUTIC EXPERIENCES IN TREATING RADIOGENIC INTESTINAL COMPLICATIONS FOLLOWING TELEGAMMA THERAPY IN THE ABDOMINAL REGION. Kraft, M.; Glaser, F. H.; Klaus, M. (Martin-Luther-Univ., Halle, Ger.). Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 112-115(1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

The radiation reactions of the intestinal tract of patients following abdominal exposure during therapy and the factors causing them were studied. Precautions before telegamma therapy reduce the complication rate. In order to decrease the total radiation reactions, a medicinal combination therapy during the radiation treatment is recommended as a prophylactic treatment. Different precautions are discussed on the basis of experience as a function of the severity of the late reactions. (tr-auth)

18919 THERAPY OF THE INTESTINAL RADIATION REACTION IN RADIATION CLINICS. Neumeister, K. (Karl-Marx-Univ., Leipzig); Pfeiffer, J.; Jahns, J.; Weinrich, B.; Luschnitz, E.; Zamecnik, J. Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 108-111(1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

In order to modify the acute intestinal radiation reaction in therapeutic abdominal irradiation, two different proposals for therapy are discussed. The first is the reduction in the gastrointestinal reactions obtained by oral administration of physiological intestinal flora. The second proposal includes dietetic care of the abdominally irradiated patients. (tr-auth)

18920 POSSIBLE WAYS OF DECREASING THE INTESTINAL RADIATION REACTION BY VARYING THE METHODICS OF IRRADIATION. Michailov, W. Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 102-107(1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

Radiation reactions of the intestine are frequently the cause for discontinuing radiation therapy of small pelvic tumors. By movement of the patient a shift is obtained in a considerable part of the intestinal loops and many sections of the colon. Therefore a relatively small part of the intestinal loops are in the field of the radiation beams. The best positions are those in which the patients are tilted head down to 70° and then slowly lowered to 30° and fixed in this position (for irradiation of small pelvic tumors) or when the patient is placed in a lateral position (for irradiation of para-aortal and abdominal lymph nodes). (tr-auth)

18921 CHANGES OF THE INTESTINAL ABSORPTION OF CARBOHYDRATES AFTER VARYING APPLICATIONS OF RADIATION TO SWINE AND AFTER ABDOMINAL IRRADIATION OF PATIENTS WITH TUMORS. Neumeister, K.; Koch, F.; Panndorf, H.; Johannsen, U.; Mehlhorn, G.; Oelssner, W. (Karl-Marx-Univ., Leipzig). Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 48-52(1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

Increases and decreases of the intestinal absorption of carbohydrates were found following fractionated abdominal irradiations of tumor patients and swine as a function of the spatial and time dose distribution. In addition to the damage to the intestinal epithelium variations in the contact time between food and intestinal wall and intestinal bleeding were assumed as resulting from these effects. (tr-auth)

18922 CLINICAL ASPECTS OF RADIATION-INDUCED CHANGES OF THE TERMINAL PART OF THE COLON IN GYNECOLOGICAL PATIENTS. Holtzhauer, R. (Friedrich-Schiller-Univ., Jena, Ger.). Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 92-94(1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

Some clinical aspects in the treatment of radiation reactions in the rectum following therapeutic irradiation of gynecological tumors are described. On the basis of experience gained it was concluded that the treatment of radiation reactions of a serious nature should be handled by specialists. A diagnostic and therapeutic regime is necessary in each case. (tr-auth)

18923 RADIATION REACTIONS OF THE INTESTINAL TRACT: CLINICAL OBSERVATIONS. Hartig, W.; Mlynek, H. J.; Strassburger, P.; Engel, C. (Karl-Marx-Univ., Leipzig). Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 88-91(1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

Clinical observations on 48 patients with radiation damage to the intestinal tract as a complication of radiation therapy were reported. Pathogenesis, symptoms, clinical picture, and therapeutic irradiation procedures are discussed. (tr-auth)

18924 SOME ASPECTS OF THE RADIATION LOAD ON THE RECTUM IN THE RADIATION THERAPY OF COLLUM CARCINOMA. Mitrov, G.; Pentschev, P. (Center for Oncology, Sofia). Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 95-98(1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

In order to reduce the radiation injury to the rectum during radiotherapy of neoplasms of the uterus a new technique for radiation therapy was developed. It consists of the use of a ^{137}Co radiation source implant. The decrease of the radiation injuries to the rectum was 58%. (tr-auth)

18925 PROLIFERATION AND AGING PROCESSES IN THE SMALL INTESTINE OF HUMANS. Rother, P. (Karl-Marx-Univ., Leipzig). Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 70-72(1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

The mitotic index was determined in about 2000 intestinal epithelial cells from 25 male white rats. The cell division rate did not change with age, but the generation, mitotic, and migration times were longer with age. There was a displacement of the villi-crypt ratio during the life of the animal. Studies of intestinal cell proliferation kinetics as a function of age were also done on human intestinal tissues. The possible relation between radiation effects and aging of intestinal epithelial cells are discussed briefly. (CH)

18926 IMPORTANCE OF GASTROINTESTINAL RADIATION REACTIONS FOR RADIATION BIOLOGY AND RADIATION THERAPY. Oelssner, W. (Karl-Marx-Univ., Leipzig). Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 3-5(1974). (In German).

From conference on reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

The importance of the radiation effect on the digestive tract, primarily caused by the high radiosensitivity of the intestinal epithelium, is examined. Possible secondary phenomena are indicated. (tr-auth)

18927 TOPICAL PROBLEMS OF THE RADIATION BIOLOGY OF THE GASTROINTESTINAL TRACT. Neumeister, K. (Karl-Marx-Univ., Leipzig). Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 6-9(1974). (In German).

From conference on reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

A brief review is given of topical and unresolved problems of radioinduced alterations of the gastrointestinal tract (com-

parative radiobiology, pathomorphology, intestinal flora, secretion, absorption, and reactions during radiotherapy). (tr-auth)

18928 ACCIDENTAL CASE OF PROFESSIONAL RADIODERMATITIS. Le Guen, M. (CEN, Fontenay-aux-Roses, France). Rayonnements Ionis. Tech. Mes. Prot.; No. 1, 49-54(Jan 1974). (In French).

A case of accidental radiodermatitis due to an iridium source is described. The development of the lesions observed is presented. The accident was reconstituted using a phantom man made of tissue-equivalent material and containing a human skeleton. The exposure conditions were determined such that the film carried by the phantom gave the same dose as that recorded by the chest dosimeter during the accident. Irradiation studies indicate that the accident which at the beginning could have been classed as an acute localized irradiation should be classed as a total heterogeneous irradiation with localized areas of particularly high exposure. The necessity of using depth dosimetry in the case of ordinary accidental radiodermatitis was demonstrated. (FR)

18929 DOSE DISTRIBUTION ANALYSIS OF MOVING-STRIP TECHNIQUE FOR ABDOMINAL IRRADIATION USING 10 MV X RAYS. Khan, F. M.; Moore, V. C.; Jones, T. K.; Stryker, J. A.; Levitt, S. H. (Minnesota Univ., Minneapolis). Radiology; 112: No. 2, 421-424(Aug 1974).

From 59th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (25 Nov 1973).

Dose distributions for the moving-strip technique with 10 MV x rays were obtained with a CDC-3300 computer. Individual field data were measured with an ionization chamber in a water phantom. Conditions were simulated to study the effect of patient thickness on dose homogeneity. Dose distributions were analyzed in terms of average dose, modal dose, and local maxima and minima. The results indicate that for the beams used in the study the dose across the strips was within ±5% under fixed treatment conditions. The effects of day-to-day variations in setup, such as field size and field positioning, were investigated. (auth)

18930 EFFECT OF LOCAL IRRADIATION ON REJECTION OF THE TRANSPLANTED KIDNEY. Abramson, N.; Ornitz, R.; Cavanaugh, P. J. (Duke Univ., Durham, NC). Radiology; 112: No. 2, 413-416(Aug 1974).

From 59th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (25 Nov 1974).

From 1965 to 1973, 54 kidney transplant patients received local radiation to the new kidney because of rejection signs. A tumor dose of 1500 rads was delivered to patients not responding to 600 or 900 rads. Nineteen patients showed reversal of rejection and are alive—median survival 30.9 months. Almost all survivors showed improvement in either BUN, creatinine clearance, or both within 10 days after the last radiation treatment. A dose-response relationship for the dose range used cannot be established. Three patients responded to 1500 rads. Use of irradiation of the transplanted kidney is recommended when signs of rejection occur. (auth)

18931 RADIATION-INDUCED CARCINOMA OF THE RECTUM. Qizilbash, A. H. (Henderson General Hospital, Hamilton, Ont.). Arch. Pathol.; 98: No. 2, 118-121(Aug 1974).

Adenocarcinoma of the rectum developed in a woman as a late complication of pelvic irradiation. The carcinoma occurred 24 years after the initial treatment for carcinoma of the cervix. The resected bowel showed evidence of radiation changes with ulceration and stricture formation. In addition a papillary well-differentiated adenocarcinoma had arisen at the margins of the ulcer with infiltration of the muscle coat of the rectum. (auth)

18932 THE APPLICATION OF A TANGENTIAL WEDGE-FILTER PENDULUM TECHNIQUE IN THE THERAPY OF BREAST CANCER. Eichhorn, H. J.; Richter, J. (Deutsche Akademie der Wissenschaften zu Berlin (German Democratic Republic). Robert-Roessle-Klinik). Strahlentherapie; 147: No. 1, 35-40(Jan 1974). (In German).

9 figs.

A tangential pendulum irradiation technique for irradiation of breast cancer using wedge-filters is described. This irradiation technique consists of three partial pendular movements: two movements of the treatment head in lateral and medial direction render possible a homogenous dose to the thoracic wall, whereas the third pendular movement is directly above the sternum with a smaller pendulum angle for the purpose of dose saturation of the parasternal lymphatic region. The dose distributions which are attainable by this technique and can be calculated by the aid of a computer, are given; additionally, a help for positioning is described. This method was tested during 3 year routine use and stood the test. (GE)

18933 COMBINATION CHEMOTHERAPY AND WHOLE LUNG IRRADIATIONS FOR PULMONARY METASTASES FROM SARCOMAS AND GERMINAL CELL TUMORS OF THE TESTIS. Wharam, M. D.; Phillips, T. L.; Jacobs, E. M. (Univ. of California, San Francisco). Cancer; 34: No. 1, 136-148(Jul 1974).

From fifteenth annual meeting of the American Society of Therapeutic Radiologists; New Orleans, LA (24 Oct 1973).

Seven patients with sarcomas and seven with testicular carcinomas with lung metastases were treated with a multiple drug regimen of actinomycin D, cyclophosphamide, and vincristine (plus mithramycin in testicular primaries) given in a 2-week cycle followed by a 2-week rest period. The patients received concurrent whole lung irradiation to 1500 rads in 10 fractions. The complete response rate was 50%. Eight patients survived more than 1 year after beginning the combination therapy. Five patients have survived from 12 to 31 months, and three have been continuously free of disease. Hematologic and gastrointestinal toxicity was acceptable. Two patients developed clinical radiation pneumonitis. The results of this pilot study suggest that multiple drug therapy combined with radiation therapy to known sites of disease and to both entire lungs may offer longer complete remissions in these patients than would result from chemotherapy or radiation therapy alone. (auth)

18934 PARA-AORTIC LYMPH NODE IRRADIATION IN CARCINOMA OF THE UTERINE CERVIX. Guthrie, R. T. (University Hospitals, Iowa City, IA); Buchsbaum, H. J.; White, A. J.; Latourette, B. Cancer; 34: No. 1, 166-168(Jul 1974).

From fifteenth annual meeting of the annual American Society of Therapeutic Radiologists; New Orleans, LA (24 Oct 1973).

Patients with advanced carcinoma of the uterine cervix, Stages III and IV, received extensive pretreatment evaluations to assess the incidence of para-aortic lymph node spread for this disease. A total of 40 patients was subjected to exploratory laparotomy for para-aortic node biopsy. Involved para-aortic nodes were found in $^{13}/_{17}$ Stage III patients (35%) and $^{2}/_{3}$ Stage IV patients. Of these 15 patients, 4 had other intraperitoneal spread, making them unsuitable for extended field radiation. Eleven patients received radiation to extended fields to cover para-aortic lymph nodes. Anterior-posterior ^{60}Co ports were used, with a daily fraction of 180 rad, to a total of 5400 rad. This therapy was tolerated fairly well. Gastrointestinal problems were the most frequent immediate and late side-effects. Of these patients, 10 completed all prescribed therapy. Five of these have died, at an average of 6.6 months following treatment; 5 are alive at 30, 21, 15, 15, and 5 months. (auth)

18935 HYPERTHERMIA: POTENTIAL AS AN ANTI-TUMOR AGENT. Suit, H. D.; Shiwayder, M. (Massachusetts General Hospital, Boston). Cancer; 34: No. 1, 122-129(Jul 1974).

From fifteenth annual meeting of the American Society of Therapeutic Radiologists; New Orleans, LA (24 Oct 1973).

Response of cells in vitro and of intact tissue in vivo, both of normal and malignant origin, to moderate levels of hyperthermia has been reviewed. Abundant laboratory and clinical evidence exists which demonstrates that tolerable levels of hyperthermia (locally applied) can regularly effect a delay in tumor growth, often a complete regression, and occasionally a permanent control of tumor. This means that in some tumors, aerobic and hypoxic cells are inactivated by the heat applied. Further, moderate hyperthermia is a potent sensitizer to ionizing radiation. The mechanism of action of hyperthermia remains unknown; however, there is prompt suppression of DNA, RNA, and protein synthesis, reduction of oxygen consumption, labilization of lysozymes, etc. Effect of heating is strongly correlated with temperature level: an increase in temperature by 1 degree C reduces time for a specified response by a factor of 2. Application of local, regional, or systemic hyperthermia to the human cancer patient alone or in combination with radiation or certain drugs may be considered as attractive potential therapy modality. At present, information about relative thermal sensitivity of normal and tumor tissue is scant. This appears to be a good area for preclinical research. (auth)

18936 REPORT ON THREE YEARS' NEUTRON THERAPY FROM THE MEDICAL RESEARCH COUNCILS CYCLOTRON AT HAMMERSMITH HOSPITAL, LONDON. Catterall, M. (Hammersmith Hospital, London). Cancer; 34: No. 1, 91-95(Jul 1974).

From fifteenth annual meeting of the American Society of Therapeutic Radiologists; New Orleans, LA (24 Oct 1973).

All of the patients in 3 years of fast neutron therapy at Hammersmith Hospital have had such advanced or radioresistant tumors that they were thought unlikely to respond to low LET radiation. Twenty percent of those referred have been too ill to be treated or have been unable to complete the course of treatment. Of 238 patients who completed their treatment by January 1973, 180 died less than 1 year after treatment of metastases or other causes, but in 135 of these, the tumors were either regressing or had completely regressed at the time of death. Fifty-eight patients survived for more than a year with no sign of tumor in the treated area, including 20 with adenocarcinoma, 14 with well-differentiated

squamous cell carcinoma, 9 with sarcomas, and 7 with salivary gland tumors. Twenty-two tumors definitely recurred or were residual, but all these received a dose which was less than the standard of 1440 rads in 12 treatments over 26 days. Eleven of the 97 patients who survived more than 6 months after treatment developed necrosis, but a precipitating factor was present in every case. Details of the results of 26 patients with buccal cavity tumors and of 31 patients with inoperable carcinoma of the stomach are given. Early results of a randomized clinical trial of the treatment of advanced tumors of the head and neck show that a greater number of tumors completely regressed with neutron than with supervoltage treatment. The results are statistically significant, but more patients are required and the trial is continuing. The techniques of fast neutron therapy are much more demanding than those of low LET radiation; the margin is narrow between the dose leading to recurrence and that resulting in necrosis. Scrupulous attention to planning and treatment is necessary in every case. (auth)

18937 EXPERIENCE WITH FAST NEUTRON THERAPY USING THE TEXAS A AND M VARIABLE ENERGY CYCLOTRON. Hussey, D. H.; Fletcher, G. H.; Caderao, J. B. (M. D. Anderson Hospital and Tumor Inst., Houston, TX). Cancer; 34: No. 1, 65-77 (Jul 1974).

From fifteenth annual meeting of the American Society of Therapeutic Radiologists; New Orleans, LA (24 Oct 1973).

Between October, 1972 and September, 1973, 72 patients were treated with neutrons produced by bombarding beryllium with 16- or 50-MeV deuterons. The clinical material included 34 patients with head and neck cancer, 11 with breast carcinoma, 8 with superior sulcus bronchogenic carcinoma, and 19 with a variety of miscellaneous neoplasms. Patients were treated twice-weekly with doses calculated to include both the neutron and gamma components. Most of the patients with head and neck cancer were treated with shrinking fields to doses of 1850 rad_{ny} /5½ weeks–2350 rad_{ny} /7 weeks with the 16-MeV beam, or 2000 rad_{ny} /6 weeks–2400 rad_{ny} /7 weeks with the 50-MeV beam. Preliminary evaluation indicates satisfactory local control; however, the late radiation sequelae are greater than would be expected on the basis of the acute mucosal reactions observed. A significant number of complications has developed in: patients treated at higher doses, and those with massive epithelial involvement even at lower doses. Consequently, doses have been reduced. With breast carcinoma, doses of 2350 rad_{ny} /7 weeks (50 MeV) with shrinking fields have been well tolerated for this short-term followup; the local control rate has been high. Eight patients with superior sulcus tumors have been well palliated with no undue side effects. However, all were treated with conventional radiotherapy followed by a neutron therapy boost to the primary site. The miscellaneous group included a wide variety of neoplasms, the number of each type too small to draw any meaningful conclusions. (auth)

18938 LYMPHOMAS: RESPONSE TO IRRADIATION. Fayos, J. V.; Edlund, J. H.; Knapp, W. T.; Campos, J. L.; Lampe, I. (University Hospital, Ann Arbor, MI). Cancer; 34: No. 1, 212-222(Jul 1974).

From fifteenth annual meeting of the American Society of Therapeutic Radiologists; New Orleans, LA (24 Oct 1973).

Four hundred eighty-four patients with lymphoma received initial irradiation at the University of Michigan from the years 1960 through 1971. No patient with staging celiotomy was included. The distribution was as follows: Hodgkin's disease, 46.9%; lymphosarcoma, 26.7%; reticulum cell sarcoma, 23.5%; and unclassified lymphoma, 2.9%. In most instances, only involved regions were irradiated in the non-Hodgkin's lymphomas. Hodgkin's disease was treated regionally, but in supradiaphragmatic disease, adjacent areas received prophylactic irradiation, in recent years with the use of a mantle. Present doses vary between 3500 to 4500 rad given in 4 to 5 weeks. Complications were minimal. The reactivation-free interval at 6 years for Stages I and II nodal was 41%, 32%, and 31% for Hodgkin's, lymphosarcoma, and reticulum cell sarcoma. A non-nodal component on first reactivation was found in 24% of Hodgkin's, 33% of lymphosarcoma, and 41% of reticulum cell sarcoma. In these two groups, systematic total nodal irradiation probably would have had no potential benefit. It was concluded that limited irradiation in early stages (after staging celiotomy) has merits. (auth)

18939 PRELIMINARY CLINICAL OBSERVATIONS AFTER EXTENDED BRAGG PEAK HELIUM ION RADIATION. D'Angio, G. J. (Memorial Sloan-Kettering Cancer Center, New York); Aceto, H.; Nisce, L. Z.; Kim, J. H.; Jolly, R.; Buckle, D.; Holt, J. G. Cancer; 34: No. 1, 6-11(Jul 1974).

From fifteenth annual meeting of the American Society of Therapeutic Radiologists; New Orleans, LA (24 Oct 1973).

Laboratory studies of single cell survival after irradiation with extended Bragg peak helium ions suggest a relative biological effectiveness (RBE) of 1.4 for oxygenated cells. A clinical radiobiological investigation has been initiated using patients with mycosis fungoides. One patient received standard total body electron beam irradiation according to the Memorial Hospital technique, which consists of six weekly doses of 400 rads. Small selected areas were shielded and received single, graduated doses of electron and helium ion extended Bragg peak therapy. Two additional comparable regions received six weekly doses of the two therapeutic beams. Changes in the severity of lesions according to a semiquantitative severity score (SS) were observed following treatment. Values for maximum reduction in the SS observed for the two therapy beams after treatment were consonant with a RBE of 1.4. Recurrence patterns after therapy with the two beams also differed. Lesions treated with the heavy particles remained under control longer than those treated with doses of electrons yielding comparable initial effects. These data suggest that, in addition to processes involved in the increased RBE for helium ions, other factors may be operating to produce a more sustained benefit from extended helium ion Bragg peak irradiation. (auth)

18940 RADIOPROTECTIVE EFFECTIVENESS AND PROBABLE MECHANISM OF ACTION OF SOME POTENTIAL RADIOPROTECTORS. Bogatyrev, G. P.; Goncharenko, E. N.; Chirkov, Yu. Yu.; Kudryashov, Yu. B. (Moscow State Univ.). Biol. Nauki; No. 5, 50-53(May 1973). (In Russian).

Some aminothiosulfuric acids were shown to be potentially radiation protective, the degree of protection afforded depending on the decrease in oxidation-reduction potential in animal tissues in the presence of these compounds. Data were obtained on the effect of these compounds on biogenic amines (serotonin, histamine), loosely bound phospholipids, and lipid oxidation products in animal tissues. The mechanism of action of the protective compounds is thought to include a "biochemical background of radiation resistance." (tr-auth)

18941 BLADDER OR RECTAL INJURY FOLLOWING RADIATION THERAPY FOR CERVICAL CANCER. van Nagell, J. R. Jr.; Parker, J. C. Jr.; Maruyama, Y.; Utley, J.; Luckett, P. (Univ. of Kentucky, Lexington). Amer. J. Obstet. Gynecol.; 119: No. 6, 727-732(15 Jul 1974).

A total of 271 patients with cervical cancer were evaluated, staged, and treated with radiation therapy, and six of these patients developed large bowel or bladder fistulas in the absence of recurrent tumor. Radiation-related bowel or bladder injury was found to occur more commonly in patients with pre-existing hypertension or diabetes mellitus. The pathophysiology of vascular disease as an etiologic factor in radiation complications is discussed. (auth)

18942 RADIATION THERAPY OF HODGKIN'S DISEASE: SIGNIFICANCE OF SPLENIC INVOLVEMENT. Shipley, W. U.; Piro, A. J.; Hellman, S. (Harvard Medical School, Boston). Cancer; 34: No. 1, 223-229(Jul 1974).

From 15th annual meeting of the American Society of Therapeutic Radiologists; New Orleans, LA (24 Oct 1973).

The influence of splenic involvement on disease-free survival was studied in 83 Hodgkin's disease patients treated with radiation therapy. Patients with splenic disease demonstrated a shorter relapse interval ($p = 0.05$), more extra-nodal relapses, and a higher rate of relapses (28% vs. 15%) than patients without splenic involvement. Patients with splenic disease have a 65% probability of disease-free survival by actuarial analysis at 24 months compared to 79% for all Stage II and III patients without splenic involvement. The additional reduction in disease-free survival in the group with splenic disease appeared to occur in the first 6 months. The disease-free survival curves in these groups are parallel beyond 6 months. These data and a retrospective matched pair analysis suggest that a small cohort (15%) of splenic positive patients do poorly with only nodal irradiation because of early extranodal dissemination, but that the majority of these patients may have a prognosis similar to patients with only lymph node disease. (auth)

18943 IMMUNOCOMPETENCE IN PATIENTS WITH SOLID TUMORS UNDERGOING COBALT 60 IRRADIATION. Clement, J. A.; Kramer, S. (Jefferson University Hospital, Philadelphia). Cancer; 34: No. 1, 193-196(Jul 1974).

From fifteenth annual meeting of the American Society of Therapeutic Radiologists; New Orleans, LA (24 Oct 1973).

Forty-eight patients with solid tumors, who had not had previous radiation or chemotherapy, were tested for cell-mediated immunity (CMI) in vivo, before and after undergoing a course of radical radiation therapy. Skin tests of CMI were performed using mumps antigen, candida antigen, tuberculin (intermediate strength), and streptokinase-streptodornase. Delayed hypersensitivity reactions were measured before and after full courses of radiation therapy. Results indicate that therapeutic doses of cobalt 60 irradiation do not adversely affect the CMI response of the majority

(77%) of cases. Nine patients were anergic at the beginning of treatment; seven of these patients became reactive to at least one antigen after completing treatment. Five patients were anergic at the end of treatment. (auth)

18944 ACUTE 2nd DEGREE BURN OF THE SKIN BY A RADIOACTIVE SOURCE. Kuzelova, M. (Regional Inst. of National Health, Pardubice, Czech.); Sabatova, M. Prakt. Lek.; 53: No. 11, 438-439(5 Jun 1973). (In Czech).

A case study is described of a patient who suffered an acute burn of the 2nd degree as a result of a careless handling of an ^{192}Ir γ source used in nondestructive testing. The skin lesion healed within three weeks after exposure. The medical examination carried out 1.5 years after exposure revealed epilation on the hand dorsum. The risks are pointed out of delayed radiation effects resulting from exposure in handling radioactive sources while not observing safety regulations. (Nuclear Sci. Abstr. Czech.).

18945 PREGNANCY AND X-IRRADIATION. Koga, S. (Fujita-Gakuen Univ., Toyoake, Japan); Maekoshi, H.; Orido, T. Sanfujinka Chiryo; 28: No. 3, 293-301(Mar 1974). (In Japanese).

The x-ray examinations and the exposure doses during pregnancy were studied and outlined referring to 59 literatures from 1923 to 1972. The chest x-ray examination, the measurement of the pelvis, the examination of twins and abnormalities of fetus and other diseases during pregnancy were described. Although the frequency of x-ray examinations during pregnancy is reported to be 13 to 17%, the real value is presumed to be higher when the indirect chest x-ray examinations in the early stage of pregnancy are included. The attention should be paid to prevent the x-ray examination of the abdomen in the early stage of pregnancy without noticing it. The exposure dose to skin is 2000 m rads by the Martius method in conditions of 85 kVp, 100 mAs and 8 : 1 HS, while the dose to the film through the body is below 0.5% in water phantom. The exposure doses to pregnant woman and fetus by the x-ray examination of the chest and the abdomen during the early stage of pregnancy, and the usual x-ray examination and the doses to skin were illustrated. The death of fetus, the abnormalities of genesis such as microcephalia and low intelligence, the induction of cancer and the genetic effects caused by the body exposure were examined referring to the literatures. The data on animal experiments were also shown. To prevent these damages, the x-ray examinations of the lower part of the abdomen and other x-ray examinations except those which are inevitable in pregnant women should not be done in the women who are possible to be pregnant. Furthermore, the chest x-ray examination and measurement of the pelvis in the late stage of pregnancy need to be reconsidered. When the usual radiography and the obstetric radiography are carried out, the exposure doses should be decreased by using high sensitized intensifying screens, films and cover boards. In the case that the fetus was exposed in the early stage of pregnancy, the judgment of abortion should be based on the correct evaluation of doses. There are opinions that insist on the necessity of abortion in cases with above 10R exposure doses, while some insist on the possibility that less than 10 R exposure doses may also induce malformations. (JA)

18946 CLINICAL USE OF DEOXYPYRIMIDINURIA AS BIOCHEMICAL DOSIMETER IN THERAPY OF MALIGNANT LYMPHOGRANULOMAS. Dienstbier, Z.; Bechyne, M.; Buric, L.; Kovarikova, H.; Blazek, L. (Charles Univ., Prague). Cas. Lek. Cesk.; 112: No. 15, 475-477(13 Apr 1973). (In Czech).

Six patients suffering from Hodgkins disease were treated both by chemotherapy and radiotherapy. A considerable increase in the excretion of pyrimidine deoxyribonucleosides could be observed following both irradiation and chemotherapy using cytostatics. The results indicate that the phenomenon cannot only be used in the evaluation of the efficiency of individual cytostatics but also in the study of malignant tumors. (Nuclear Sci. Abstr. Czech.)

18947 TUMOR THERAPY WITH HIGH-IONIZING RADIATION. Wideroee, R. (Univ., Zurich). pp 55-61 of Proceedings of the Third All-Union Conference on the Charge Particle Accelerators. Moscow; Izdatel'stvo Nauka (1973).

The biological processes in human cells when the tumor region is exposed to ionizing radiation are described. It is shown that the best therapeutic results are achieved when the right type of radiation and the right treatment scheme are used: Survival curves of cultured human kidney cells are presented as a function of the dose for various types of radiation (α particles from ^{210}Po source, cyclotron accelerated deuterons, x rays, and β particles from a ^{90}Y source). (INIS)

18948 BONE MARROW TRANSPLANTATION. Hirajima, K. (National Inst. of Radiological Sciences, Chiba, Japan). Ketsueki To Myakkan; 4: No. 3, 311-322(Mar 1973). (In Japanese).

Technical improvements and possibilities for the clinical application of bone marrow transfusions are described. It was first tried as a therapeutic measure in personnel with radiation injury. Fundamental studies of hematology and immunology were carried out. From the clinical point of view, there was a problem that secondary disease was caused by immunological incompatibility. When bone marrow transplantation was carried out in animals, immune reactions in recipients were decreased by more than LD_{50} by irradiation or agents such as cyclophosphamide and azathioprine. When brothers or sisters were selected as donors, immunological compatibility was found. About 1×10^{10} of bone marrow cells were taken from the donor, and drip transfusion was performed in the recipient. Infection was avoided to prevent secondary disease. In the treatment of cases with leukemia, aplastic anemia, immuno-insufficiency, and radiation syndrome, bone marrow transfusion was tried. In the cases exposed to less than 600 rem of irradiation immune reactions were manifest except when the donor was an identical twin. Another problem in bone marrow transfusion was the inhibition of secondary disease. (JA)

18949 COLON STENOSES FOLLOWING IRRADIATION OF RENAL TUMOURS. Ruebe, W.; Seegelken, K. (Knappschafts-Krankenhaus, Recklinghausen (F. R. Germany). Strahleninstitut). Strahlentherapie; 147: No. 1, 63-68(Jan 1974). (In German).

5 figs.; 33 refs.

Radioreactions in the gastrointestinal tract after x-ray and ^{60}Co teletherapy of renal tumors are sporadically described in literature. The irradiation of the right renal bed causes changes in the duodenum, whereas irradiation of tumours situated in the left renal bed leads to damage of the colon. For 196 patients with renal tumors, personally treated by the authors, 5 stenoses of the splenic flexure and its close environment were observed, which were diagnosed 5 to 26 months after application of focal doses between 3,600 and 6,000 rd. Clinical and radiological symptoms are described, etiological problems are discussed; the necessity of a sufficient oncolytic dose is underlined. (auth)

18950 VOLUME CHANGES IN NORMAL LYMPH NODES AFTER RADIO- AND CHEMOTHERAPY. Sauer, R.; Elke, M.; Hug, I.; Schmid, P. (Basel Univ. (Switzerland). Inst. fuer Roentgendiagnostik und Strahlentherapie). Strahlentherapie; 147: No. 1, 82-90(Jan 1974). (In German).

2 figs.; 4 tabs.; 22 refs.

The volume changes in normal lymph nodes were quantitatively determined on 99 patients with repeated lymphographies: After their first lymphography, one group of the patients was irradiated, another treated with chemotherapy, the rest remained without treatment. During the observation period, non-treated lymph nodes, those irradiated with less than 2,000 R and those treated solely with chemotherapy showed no difference in the reduction of their volume. Permanent changes were not observed. Irradiation with more than 2,000 R accelerated the volume reduction of the lymph nodes and caused irreversible shrinking. This was demonstrated by significantly reduced initial volumes at repeated lymphographies. The initial volume of the lymph nodes after repeated lymphography no doubt was determined by the mode of the previous therapy, but the further volume behavior was independent of the initial volume and equal in all treated groups. (GE)

18951 THE CHANGE IN BEHAVIOUR OF SODIUM AND POTASSIUM IONS IN THE TUBULI OF THE HUMAN KIDNEY UNDER LOCAL COBALT-60 IRRADIATION. Is There an Immediate Biological Reaction With Subsequent Recovery. Schmidt, H. G.; Dietzel, F.; Schirmer, G.; Caha, A.; Roedel, K.; Ringleb, D. (Giessen Univ. (F. R. Germany). Wilhelm-Conrad-Roentgen-Klinik). Strahlentherapie; 147: No. 1, 77-81(Jan 1974). (In German).

1 fig.; 9 refs.

The influence of biaxial pendulum irradiation of the paraaortal lymph node chains on glomerular filtrate, sodium rejection, urea clearance, and potassium elimination was tested on Hodgkin's patients with normal kidneys. No significant changes were observed in the glomerular filtrate, urine flow, urea clearance, and potassium elimination, under a 4-minute pendulum irradiation of the renal area with 80 R HD. On the contrary, the sodium rejection under irradiation increased by 90% of the initial value and fell to almost the initial value after the end of irradiation. The origin of this immediate reaction is discussed under nephrological aspects. (auth)

18952 POSSIBLE CONSEQUENCES OF AN EXCESSIVE MEDICAL RADIATION EXPOSURE IN THE UNITED STATES OF AMERICA. Morgan, K. Z. Roentgen Bl.; 27: No. 3, 127-142 (Mar 1974). (In German).

From seventh annual meeting: the radiation exposure of the population due to the application of ionizing radiation in medical diagnostics; Bern, Switzerland (21 Mar 1973).

2 figs.; 6 tabs.; 29 refs.

The use of ionizing radiation in medicine provides the greatest portion of exposure today to sources of artificial radioactivity

both for the individual and for the total population. In addition, it has been known for a long time that even the radiation doses necessary to obtain a picture satisfactory for assessment purposes can also produce biological effects. The results of research in recent times have also shown that leukemias and tumors induced by the radiation appear after investigations in which the fetus has been exposed to additional radiation within the womb. For this reason the usefulness of such examinations must be set against the risks associated with them in each case. In the United States of America attempts are being made to protect patients from unnecessary radiological examinations. The measures needed for this purpose are discussed in detail and suggestions given for keeping the exposure to radiation as low as possible for the individual, in spite of the constantly increasing number of examinations. (auth)

18953 PATIENT EXPOSURES IN DIAGNOSTIC RADIOLOGY: PROTECTION PROBLEMS OF CURRENT CONCERN. A Statement Issued by the International Commission on Radiological Protection (ICRP) July 1973. Strahlentherapie; 147: No. 1, 101-104(Jan 1974).

8 refs.

The topics of the ICRP statement are: (1) The protection of the patient is necessary and important; (2) A benefit-risk balance has to be made; (3) There must be a larger dissemination of the ICRP Recommendations; (4) The frequency of conventional x-ray examinations increases continuously; the application fields and different examination techniques increase and in many cases the exposure time, too, with the consequence of a higher patient dose; (5) For all examinations the radiation dose to all tissues, not only to the gonads and bone marrow, has to be restricted to the practical minimum; (6) There have to be made increased reinforcements in order to reduce the radiation dose to the patient by improvement of the examination techniques and the devices. (GE)

18954 THE RESULTS OF DOSE MEASUREMENTS DURING CEREBRAL ANGIOGRAPHY, USING VARIOUS TYPES OF ANGIOGRAPHIC EQUIPMENT. Fiebach, O.; Loehr, E. (Essen Univ. (Gesamthochschule) (F. R. Germany). Radiologisches Zentrum); Ewen, K. (Zentralstelle fuer Sicherheitstechnik, Strahlenschutz und Kerntechnik des Landes Nordrhein-Westfalen, Duesseldorf (F. R. Germany)). Fortschr. Geb. Roentgenstr. Nuklearmed.; 120: No. 5, 573-577(May 1974). (In German).

2 figs.; 2 tabs.; 2 refs.

Dose measurements were carried out during routine cerebral angiography (eyes of the patients and angiographer, gonadal area of the patient and left hand of the angiographer). Two types of angiographic equipment were used (conventional apparatus high-power device). The dose, using the high-power device, was two to five times greater than that from the conventional apparatus. Using special precautions it was, however, possible to reduce the dose from the high-power device almost to the level of the conventional apparatus. (auth)

Vertebrates

Refer also to abstracts 18847, 18868, 18870, and 20552.

18955 (N-73-31999) EFFECT OF CONTINUOUS LOW DOSE-RATE GAMMA IRRADIATION ON CELL POPULATION KINETICS OF LYMPHOID TISSUE. Semiannual Status Report. Foster, B. R. (Grambling Coll., La. (USA)). 13 Jul 1973. 23p. (NASA-CR-135723; SASR-4). NTIS $3.25.

Cell proliferation in mice thymus undergoing irradiation at a dose rate of 10R/day for 105 days was studied. Specifically, the aim was to determine whether or not a steady state of cell population can be established for the indicated period of time and what compensatory mechanisms of cell population are involved. (auth)

18956 (ORO-3832-27) LONG-TERM EFFECTS OF IONIZING IRRADIATION ON CEREBRAL CORTEX. Final Report. Brizzee, K. R. (Tulane Univ., Covington, La. (USA). Delta Regional Primate Research Center). 1974. Contract AT(40-1)-3832. 16p. Dep. NTIS $4.00.

Results are summarized from studies on the effects of exposure to various doses of γ radiation as fetuses, infants, or young adults on brain development, chemical composition, and ultrastructure in squirrel monkeys, rhesus monkeys, and rats. A list is included of 21 publications during the time period covered by this report that present the results in detail. (CH)

18957 RADIATION PATHOLOGY OF MEMBRANE-BOUND DIGESTION. Gavrilov, R. I. Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 45-47(1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

Rats and mice were irradiated with x rays at doses from 350 to 1200 R. At different times after the irradiation (4 hrs to 30 days) the digestive process in the proximal and distal sections of the small intestine were determined. Variations in the digestive activity after irradiation were established. (tr-auth)

18958 STIMULATION OF LEUKEMOGENESIS IN AKR AND AKR/T1 ALD MICE BY X RAYS. Leonard, A.; Deknudt, G.; Linden, G. (Centre d'Etudes de l'Energie Nucleaire, Mol, Belg.). Compt. Rend. Soc. Biol.; 167: No. 6, 1055-1057(1973). (In French).

The spontaneous chromosome anomaly observed in AKR/T1 mice appears to be correlated with a slight increase in the rate of occurrence of leukemia together with a reduction in latent time. It is, however, possible that the differences observed are due to the origin of the animals. The administration of 4 175R doses of radiation at weekly intervals to young animals reduces the latent time by about 30%, but does not affect the rate of occurrence of leukemia. (FR)

18959 EFFECT OF FRACTIONATED DOSE-PATTERNS OF X-RADIATION ON THE SURVIVAL OF EXPERIMENTAL SKIN FLAPS IN THE PIG. Wiernik, G.; Patterson, T. J. S.; Berry, R. J. (Churchill Hospital, Oxford). Brit. J. Radiol.; 47: No. 558, 343-345(Jun 1974).

Fields on the flanks of domestic swine were irradiated with 250 kVp X rays in courses of six fractions/18 days and 30 fractions/39 days. These fields were converted into full-thickness skin flaps from one week to six months after the last irradiation. Radiation damage was quantitated by measuring the length of flap that survived. For fractionated exposures there is a close correlation between the time at which the course of irradiation was begun and the time at which the survival of the skin flaps decreases. Implications for the combination of pre-operative radiotherapy with surgery in human cancer treatment are discussed. (auth)

18960 INFLUENCE OF RADIOPROTECTIVE SUBSTANCES ON THE TRANSPORT AND ULTRASTRUCTURE OF THE INTESTINAL WALL. Dienstbier, Z.; Hlavaty, V. (Charles Univ., Prague). Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 42-44(1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

Administration of AET had a favorable effect on ^{22}Na intestinal transport in irradiated rats. It also favorably affected the water and glucose transport altered by the irradiation. The studies were made on rats irradiated with x rays at 300, 600, and 1200 R. It was established that phytourease, which clearly increased the percentage of survival after irradiation, also protected histologically the intestinal mucosa against radiation damage. (tr-auth)

18961 FUNCTIONAL DISTURBANCES IN THE STOMACH OF IRRADIATED RATS. Visnovsky, P. (Comenius Univ., Martin, Czech.); Grossmann, V. Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 38-41(1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

The gastrointestinal motility disturbances in rats irradiated with 600 R were shown by the delay in the stomach emptying. These changes were considerable only one hr after exposure and reached their high point three days after irradiation. The extent was dependent on the radiation dose, the age of the animals, and the body section irradiated. After irradiation at 600 R there was a reduction of HCl secretion five hrs after exposure and on the 6th and 9th day after irradiation. (tr-auth)

18962 CHANGES IN MOTILITY, SECRETION, AND RESORPTION IN THE DIGESTIVE TRACT OF IRRADIATED RATS. Grossmann, V.; Chmelar, V.; Kvetina, J. (Charles Univ., Hradec Kralove, Czech.). Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 33-37(1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

The disturbances of the digestive tract and their effect on drug absorption were followed during the acute phase of radiation sickness in rats after x-irradiation at 600 R. It was established that in addition to an increased stomach retention there was also a reaction to the pressure variations of solutions infusing into the intestine at a standard rate. The passage time through the small intestine and the weight of the small intestine was reduced somewhat. There was also a change in the bile secretion and drug absorption. The oral administration of drugs during this phase of radiation sickness appears inadvisable because of the uncertain drug absorption. (tr-auth)

18963 COURSE OF GASTROINTESTINAL RADIATION REACTIONS IN RATS (A DEMONSTRATION EXPERIMENT). Neumeister, K.; Jahns, J.; Paul, R. (Karl-Marx-Univ., Leipzig).

Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 29-32(1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

For improvement of the academic course in radiobiology and of the radiobiological part of medical training, model studies for the demonstration of radiation injuries were developed using rats. A clear dose dependence of the gastrointestinal radiation reaction was shown in these experiments. (tr-auth)

18964 FUNCTIONAL X-RAY INVESTIGATIONS OF THE GASTROINTESTINAL TRACT IN DOGS AND RABBITS AFTER WHOLE-BODY IRRADIATION. Papoyan, S. A.; Sagatelyan, G. M. (Radiobiology Section, Erevan). Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 27-28(1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

The variations of the functional activity of the organs of the gastrointestinal tract were investigated in dogs and rabbits after whole-body x-irradiation at 600 R for dogs and 1000 R for rabbits. The variations are correlated with pathological-anatomical studies and variations of the organs of the gastrointestinal tract in the two animals. (tr-auth)

18965 SUPPLEMENTARY PATHO-MORPHOLOGICAL INVESTIGATIONS OF THE GASTROINTESTINAL TRACT AFTER VARYING APPLICATIONS OF RADIATION TO PIGS. Johannsen, U.; Koch, F.; Mehlhorn, G.; Panndorf, H.; Neumeister, K. (Karl-Marx-Univ., Leipzig). Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 20-26(1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

Pathomorphological studies on the gastrointestinal tract of 3-month old swine showed at the time of death various types of damage according to the radiation dose and dose rate. After whole-body x irradiation (680 R and death after 107 hrs) there were shock-induced intestinal lesions. After fractionated abdominal irradiation (6 × 400 R and death after 113 hrs) there was intestinal radiation injury. Since death in both groups (especially in the whole-body irradiated group but also in the case of abdominal irradiation) did not occur at the high point of the intestinal damage, supplementary pathogenic factors such as excessive increase of E. coli in the intestine and its endotoxin production are discussed. Certain differences in the abdominal irradiation with respect to the changes in the small intestinal and large intestinal mucosa led to the assumption that the small intestine crypt cells have earlier and more ordered regeneration than the large intestinal crypt cells. (tr-auth)

18966 PATHOPHYSIOLOGICAL INVESTIGATIONS OF THE GASTROINTESTINAL TRACT AFTER VARYING APPLICATIONS OF RADIATION TO PIGS. Neumeister, K.; Panndorf, H.; Koch, F.; Mehlhorn, G.; Johannsen, U. (Karl-Marx-Univ., Leipzig). Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 15-19(1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

After fractionated abdominal x irradiation of swine (6 × 250 R, 3 × 400 R, and 6 × 400 R) a delay in the initiation of stomach emptying and a delay of the intestinal passage was established by x-radiography. These results were dependent on the gravity of the clinical symptoms and on the dose administered. Studies of some liver functions (elimination function, biliary dye metabolism, and transaminases in the plasma) showed no variations. (tr-auth)

18967 ACUTE GASTROINTESTINAL RADIATION REACTIONS AFTER VARYING APPLICATIONS OF RADIATION TO PIGS. Koch, F.; Mehlhorn, G.; Neumeister, K.; Panndorf, H.; Johannsen, U.; Gursky, S.; Oelssner, W. (Karl-Marx-Univ., Leipzig). Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 10-14(1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

The gastrointestinal reactions of swine after single lethal whole-body and sublethal to lethal fractionated abdominal irradiation with x rays are reported. The symptoms of the gastrointestinal reactions after lethal whole-body and abdominal irradiation and after differing doses in the abdominal irradiation are compared and discussed. (tr-auth)

18968 PASSAGE OF ^{88}Y THROUGH THE GASTROINTESTINAL TRACT OF IRRADIATED RATS. Vondracek, V.; Hradil, J. (Medical Research Inst., Hradec Kralove, Czech.). Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 53-56 (1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

The effect of whole-body irradiation with 500 R of ^{60}Co γ radiation on the passage rate of ^{88}Y through the gastrointestinal tract of rats was studied. The emptying of the ^{88}Y from the stomach was represented by a simple exponential function. In the irradiated rats the emptying of the ^{88}Y from the stomach was retarded more than four times in comparison with control rats. The residence time of the ^{88}Y in the gastrointestinal tract in the irradiated rats was longer when the radiation dose of the ^{88}Y to the tissues of the gastrointestinal tract was larger. (tr-auth)

18969 ROLE OF INTESTINAL MICROFLORA IN RADIATION PATHOLOGY. Kiselev, P. N.; Meter, I. D. Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 67-69(1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

The role of bacterial endotoxins in the pathogenesis of the intestinal radiation syndrome and in intestinal death was studied. The detection of the endotoxin was done by means of a sensitivity heightening of the research animals (white mice). The results are discussed. They show that in the therapy for the symptoms of acute radiation sickness special attention must be given to actions that cause a specific and non-specific detoxification of the bacterial endotoxin. (tr-auth)

18970 ROLE OF ENDOTOXIN IN THE INTESTINAL SYNDROME OF RADIATION SICKNESS. Bertok, L.; Kocsar, L. T. Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 65-66(1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

Both the symptoms of the intestinal syndrome and the pathological changes of radiation sickness indicate that the endotoxins originating from the intestinal tract can play an important role in the pathogenesis of this sickness. In order to detect endotoxemia in whole-body x irradiated rats at 800 R the lead acetate-induced endotoxin hypersensitivity method devised by Selye was used. Endotoxemia occurred after i.v. lead acetate injection after irradiation. (tr-auth)

18971 ROLE OF MICROFLORA IN THE PATHOGENESIS OF THE INTESTINAL RADIATION SYNDROME. Mraz, J.; Mandel, L.; Moravek, F. Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 61-64(1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

Young normal swine died when they were irradiated with a supralethal dose of 1200 R γ radiation. There was 100% fatality in three to five days after irradiation (intestinal death). At the time of their death the intestinal epithelium was completely destroyed. Germ-free piglets, irradiated with the same dose of 1200 R, died 12 to 14 days after irradiation (histological death). Their intestinal epithelium was histologically completely normal on the 3rd to the 5th day. In order to explain these differences and the pathogenic role of the endotopins of intestinal microflora during radiation sickness, experiments were carried out and the results are described and discussed. (tr-auth)

18972 INFLUENCING THE RETENTION OF RADIOSTRONTIUM BY MEANS OF CHEMICAL RADIOPROTECTORS IN IRRADIATED RATS. Varga, L.; Mate, L.; Feher, I. Wiss. Z. Karl-Marx-Univ., Leipzig, Math.-Naturwiss. Reihe; 23: No. 1, 57-60 (1974). (In German).

From conference on radiation reactions of the gastrointestinal tract; Leipzig, Germany (27 Apr 1973).

After whole-body x irradiation with 300 R the retention of orally administered ^{85}Sr in rats increased. Radioprotective compounds such as AET, guanidoethyl disulfide, and guanidoethyl thiosulfonic acid compensated the radiation effects, increasing the retention. The radioinduced retention increase was the result of changes in the permeability of the intestinal epithelium and the retardation of the intestinal motility. The radioprotective compounds exerted their effect either through the protection of the epithelium cells of the intestine or through blocking the transport of the plasma protein. (tr-auth)

18973 PROTECTION BY CORYNEBACTERIUM GRANULOSUM AGAINST RADIATION-INDUCED ENHANCEMENT OF ARTIFICIAL PULMONARY METASTASES OF A MURINE FIBROSARCOMA. Milas, L. (National Cancer Inst., Bethesda, MD); Hunter, N.; Basic, I.; Withers, H. R. J. Nat. Cancer Inst.; 52: No. 6, 1875-1880(Jun 1974).

Intraperitoneal treatment of C3Hf/Bu mice with killed Corynebacterium granulosum bacteria before intravenous inoculation of cells from a syngeneic fibrosarcoma greatly reduced the number of metastatic nodules in the lung. In contrast, the number of pulmonary metastases was significantly increased in mice previously given whole-body irradiation of 200–600 rads of γ-rays. Pretreatment of animals with C. granulosum before irradiation not only abolished this effect but also produced a response equal to that in mice treated with the immunostimulant alone. C. granu-

losum protected the mice against radiation-induced enhancement of pulmonary metastases if given within 2, but not at 4, weeks before irradiation. However, if mice were first irradiated and then, 1 or 2 days later, treated with C. granulosum, the radiation effect on the formation of pulmonary metastases was not influenced. (auth)

18974 DEGRADATION OF DESOXYRIBOPOLYNUCLEOXIDES IN THE LYMPHATIC TISSUES OF RATS AFTER IRRADIATION: RADIOPROTECTING ACTION OF SHIRKHESHT. Rouhanizadeh, N.; Samii, S.; Khalkhali, Z. (Teheran Univ. Nuclear Centre). Radioprotection; 8: No. 4, 277-281(1973). (In French).

The radioprotective action of a natural substance, Shirkhesht, was studied by a simple biochemical evaluation of the DNP complex of the irradiated animals prior and after application of Shirkhesht. The sensitivity of the DNP complex of the irradiated lymphopoietic tissues was also investigated. Considerable changes occur in the DNP complex of the irradiated animals. Shirkhesht appears to moderate these changes to an appreciable extent. (FR)

18975 ABNORMALITIES IN THE SHAPE OF MURINE SPERM AFTER ACUTE TESTICULAR X IRRADIATION. Bruce, W. R.; Furrer, R.; Wyrobek, A. J. (Univ. of Toronto). Mutat. Res.; 23: No. 3, 381-386(Jun 1974).

The fraction of murine epididymal sperm with shape abnormalities ranged from 1.0 to 15.0% in 14 inbred strains and hybrids studied. The effect of x rays on this fraction was examined in mice with markedly different natural levels of abnormalities, C57BL (9.4%) and (C57BL × C3H) F_1 (1.0%). Dosages of 30, 100, and 300 rad produced a significant increase in the number of abnormal forms, especially from 3 to 8 weeks following irradiation. The fraction of abnormal sperm at 5 weeks following graded doses of radiation from 0 to 300 rad increased from control values to 30%. The data for the hybrid fitted a curve which increased as the 3/2 power of the dose and which gave a doubling in abnormalities compared with control at 28 rad. Sperm abnormalities may permit a simple quantitative assay for damage to the genetic material of the male germ line. (auth)

18976 SPONTANEOUS AND RADIATION-INDUCED TUMORS IN ANIMALS. Maisin, J. R. (Centre d'Etude de l'Energie Nucleaire, Mol, Belgium). Biomedicine; 20: No. 2, 102-108(Mar 1974).

Some of the physical and biological factors related to the mechanisms of radiation-induced cancers are examined. An understanding of mechanisms of radiocarcinogenesis can not be separated from problems related to carcinogenesis in general and needs a multidisciplinary approach. Generalization of a qualitative nature have been possible on the basis of animal data, and these may be useful to understand how cancers occur following irradiation in man. However, a quantitative determination of the risk estimate in man was not possible on the basis of the limited data available. (FR)

18977 CONTROL OF RAT TESTICULAR MONOAMINE OXIDASE ACTIVITY: AGE, SEASONALITY, MELATONIN, hCG, FSH, STARVATION, AND IRRADIATION. Urry, R. L. Logan, UT; Utah State Univ. (1974). 128p. University Microfilms Order No. 74-13,270.

Thesis (Ph. D.).

A number of investigations were undertaken to determine what factors control testicular MAO activity. Hypophysectomy of immature male rats at 3 weeks of age, or mature rats at 10 weeks of age, significantly reduced testicular weight and total MAO activity. The specific activity of the enzyme was increased by hypophysectomy. Treatment of hypophysectomized rats with FSH increased testicular weight and total MAO activity. Additions of 2 IU or 5 IU of FSH to seminiferous tubules in tissue culture also increased testicular MAO activity. Treatment of hypophysectomized rats with a combination of FSH, LH, and prolactin or treatment with hCG increased testicular weights but decreased MAO activity. Injections of 1 or 2 mg of melatonin into mature hypophysectomized rats increased testicular MAO activity. Additions of melatonin in vitro at concentrations of 10^{-5} through 10^{-7} M also increased MAO activity. Treatment of male rats with either 10 or 100 μg of estradiol benzoate had no effect on testicular MAO activity. Restriction of feed intake by 47% reduced testicular MAO activity and this was attributed to a decrease in FSH. Restriction of feed by 67% increased pineal weight, hydroxyindole-O-methyltransferase activity, N-Acetyltransferase activity and testicular MAO activity; this increase was attributed to an increase in melatonin. Treatment of animals with 250 R whole-body x-irradiation increased MAO activity from 7 to 16 days after treatment. The increase in MAO activity 1 week after treatment corresponded with a previously noted increase in melatonin synthesis for the same period. Treatment of animals with 450 R of whole-body or testes only x irradiation significantly decreased testicular weights and increased testicular MAO activity as expressed on a per mg of tissue basis. Irradiation with 450 R to the head-only lowered testicular MAO activity one-hour after treatment. Pinealectomy increased testicular MAO activity. Testicular MAO did not appear to have a circadian rhythm in its activity. Injections of pargyline, an MAO inhibitor, significantly inhibited testicular MAO while increasing endogenous serotonin concentrations. Testicular MAO was observed to be localized mainly in the walls of the seminiferous tubules where it fluctuated with age. The ratio of activity in the seminiferous tubules to whole tissue was high in the young animal and low in older animals. Activity appeared to be lost in the seminiferous tubules during senescence faster than it was in the interstitial cells, thus shifting the ratio. Treatment of animals with pargyline prevented return of testicular MAO activity in seminiferous tubules grown in tissue culture. Control seminiferous tubule MAO activity increased from 6 to 9 days after placing in tissue culture while those treated with pargyline did not have this increase. (Diss. Abstr. Int., B)

18978 RADIATION-INDUCED CHANGES IN PULMONARY PERFUSION. Freedman, G. S.; Lofgren, S. B.; Kligerman, M. M. (Yale-New Haven Hospital). Radiology; 112: No. 2, 435-437(Aug 1974).

From 59th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (25 Nov 1973).

Thirty-two rabbits received a single dose of 750, 1,500, 3,000, or 3,500 rads to the right lung, while another group received a single dose of 4,500 to 6,000 rads. Unusual perfusion changes observed included (a) early hyperemia and increased perfusion during the first week after 1,500 to 3,500 rads and (b) decreased perfusion 2 to 4 hours after lethal doses (4,500 to 6,000 rads). (auth)

18979 CHANGES IN PULMONARY COMPLIANCE AND PRODUCTION OF FIBROSIS IN X-IRRADIATED LUNGS OF RATS. Shrivastava, P. N.; Hans, L.; Concannon, J. P. (Allegheny General Hospital, Pittsburgh). Radiology; 112: No. 2, 439-440(Aug 1974).

From 59th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (25 Nov 1973).

Changes in expansibility of the lungs and thorax after single-fraction x irradiation of the chest in rats were measured for exposures up to 3,000 R. Six weeks after irradiation, compliance was found to be markedly reduced from normal values for exposures above 1,500 R, as measured by the slope of the pressure-volume curve. Trichrome staining demonstrated no increase in collagen related to pulmonary fibrosis. (auth)

18980 CATALASE ACTIVITY IN RAT TESTICULAR PREPARATIONS: DISTRIBUTION AND CHANGES IN ACTIVITY INDUCED BY HYPOPHYSECTOMY AND X-IRRADIATION. Buhrley, L. E.; Ellis, L. C. (Utah State Univ., Logan). Contract AT(11-1)-1602. Fert. Steril.; 24: No. 12, 956-961(Dec 1973). (COO-1602-29).

Catalase activity (EC 1.11.1.6) was measured in rat testes from control, hypophysectomized, and irradiated rats (150 R) with standard manometric technics. A comparison was made of the enzyme activities of minced testicular preparations and teased-tubular preparations for all groups of animals. Catalase activity was greater in all of the minced preparations than in the teased-tubular preparations, as has been previously observed in this laboratory for steroid biotransformations. Hypophysectomy markedly reduced total catalase activity of rat testicular tissue when the data were expressed on a per milligram of tissue basis, due to a loss of germinal elements of the gonad. The enzyme was assumed to be preferentially located in a relatively stable testicular cell type which was not as severely affected by the withdrawal of gonadotropins (i.e., interstitial cells and Sertoli cells). Irradiation increased catalase activity for 4 to 31 days post-treatment but decreased it during the 35- to 50-day period, indicating a physiologic role of this enzyme in the testis. (auth)

18981 RESPONSE OF MOUSE INTESTINE TO NEUTRONS AND GAMMA RAYS IN RELATION TO DOSE FRACTIONATION AND DIVISION CYCLE. Withers, H. R. (M. D. Anderson Hospital and Tumor Inst., Houston); Mason, K.; Reid, B. O.; Dubravsky, N.; Barkley, H. T.; Brown, B. W.; Smathers, J. B. Cancer; 34: No. 1, 39-47(Jul 1974).

From fifteenth annual meeting of the American Society of Therapeutic Radiologists; New Orleans, LA (24 Oct 1973).

Using an assay for jejunal crypt stem cell survival, the biological effectiveness of two cyclotron-produced neutron beams relative to one another and to ^{60}Co γ radiation was determined at doses of the order used per fraction in clinical trials of neutrons. Dose survival curves were determined using up to 5 doses of neutrons and up to 20 dose-fractions of γ rays. There is little sparing of jejunal mucosa as a result of repair of sublethal injury during intervals between neutron dose fractions, whereas such repair is considerable when γ-ray doses are fractionated. The response of jejunal crypt stem cells to both neutron and gamma radiation shows considerable

variation throughout the division cycle, but the variation is less with neutrons. (auth)

18982 RBE OF NEUTRONS IN VIVO. Fu, K. K.; Phillips, T. L.; Rowe, J. R. (Univ. of California, San Francisco). Cancer; 34: No. 1, 48-53(Jul 1974).

From fifteenth annual meeting of the American Society of Therapeutic Radiologists; New Orleans, LA (24 Oct 1973).

The potential for neutrons in radiation therapy depends on a differential in RBE for tumor versus normal tissues. To study the responses of normal and tumor tissues to 15-MeV and ^{252}Cf neutrons were compared with responses to ^{137}Cs gamma or 300-kVp x rays in the mouse in vivo. Using 1% survival as a biological end point, the RBEs of 15-MeV and ^{252}Cf neutrons were 2.3 and 5.1 (^{137}Cs at 4.5 rads/min) respectively for the EMT6 tumor and 1.5 and 2.5 (^{137}Cs at 4.5 rads/min) respectively for bone marrow CFUs. For pulmonary and esophageal lethality, the RBE values of 15-MeV neutrons were 2.2 and 4.1. With 15-MeV neutrons, the RBE for the tumor was greater than the bone marrow CFU. The RBE for pulmonary lethality was less than that for esophageal lethality. With ^{252}Cf, the RBE for the EMT6 tumor, although greater than the bone marrow CFU, was not significantly different from reported in vivo RBE values of normal tissues at comparable gamma dose rates. (auth)

18983 BIOLOGICAL CHARACTERIZATION OF A HIGH ENERGY NEUTRON BEAM FOR RADIATION THERAPY. Montour, J. L.; Wilson, J. D.; Rogers, C. C.; Theus, R. B.; Attix, F. H. Virginia Commonwealth Univ., Richmond). Cancer; 34: No. 1, 54-64(Jul 1974).

From fifteenth annual meeting of the American Society of Therapeutic Radiologists; New Orleans, LA (24 Oct 1973).

In anticipation of the use of the Naval Research Laboratory (NRL) 35-MeV neutron facility for radiotherapy by the Middle Atlantic Neutron Therapy Association (MANTA), RBE values were obtained for a diversity of biological end points. Animals were exposed to neutrons at a dose-rate of approximately 60 rads/min, in Lucite exposure chambers, which also served as scattering material. Parallel experiments were performed, using the same exposure apparatus, in which animals were exposed to ^{60}Co gamma rays given at approximately 100 rads/min. RBE values were found as follows: mouse $LD_{50/5}$ 1.68; mouse $LD_{50/30}$ 1.80; mouse endogenous spleen colonies, 1.58; mouse thymic involution (ED_{50}) 1.45; mouse splenic involution (ED_{50}), 1.40; chick $LD_{50/30\ hour}$ 1.81. (auth)

18984 COMPARISON OF RADIATION CONTROL OF PULMONARY METASTASES IN C3H MICE BY HELIUM IONS OR COBALT-60 PHOTONS. El-Mahdi, A. M.; Shaeffer, J.; Aceto, H.; Constable, W. C. (Univ. of Virginia, Charlottesville). Cancer; 34: No. 1, 130-135(Jul 1974).

From fifteenth annual meeting of the American Society of Therapeutic Radiologists; New Orleans, LA (24 Oct 1973).

If C3HBA adenocarcinoma cells are injected I.V. into C3H/HeJ mice, lung colonies will result. One-week-old colonies are occult (microscopic), whereas 2-week-old colonies are manifest (macroscopic). The lungs of groups of mice with occult or manifest colonies were irradiated using either a helium ion beam or a ^{60}Co teletherapy unit. Results were expressed as dose-response curves. The ratios of D_{10} manifest to occult were 2.24 for ^{60}Co and 2.62 for helium ions. The radiobiological effectiveness of helium ions compared to ^{60}Co at the D_{10} level was 1.47 and 1.25 for the occult and manifest tumors, respectively. (auth)

18985 PROTECTION OF LETHALLY IRRADIATED MICE BY SPLEEN CELLS FROM NEONATALLY THYMECTOMIZED MICE. Yunis, E. J.; Good, R. A.; Smith, J.; Stutman, O. (Minnesota Univ., Minneapolis). Proc. Nat. Acad. Sci. U. S. A.; 71: No. 6, 2544-2548(Jun 1974).

Long-lived, immunologically vigorous ($C3H_f \times A_f$)F_1 hybrids were produced after lethal irradiation by administration of spleen cells from $C3H_f$ or syngeneic donors. Further, neonatally thymectomized $C3H_f$ or A_f strain donors reconstituted irradiated $C3H_f$ or ($C3H_f \times A_f$)F_1 hosts. In addition, $C3H_f$ spleen cells from non-thymectomized 10- to 15-day-old donors protected irradiated hybrid mice, but A_f cells of young mice as well as of older mice produced graft-versus-host reaction and early death in irradiated $C3H_f$ or ($C3H_f \times A_f$)F_1 hybrids. Abrogation of secondary disease by treatment of irradiated mice with spleen cells from allogeneic neonatally thymectomized mice is possibly attributable to diminished immunologic competence of the cells grafted, followed by the development of immunological tolerance of the donor cells. Donor cells, receiving thymus influence in the recipient host after transplantation, could explain the long-lived immunologically vigorous radiation chimeras that did not experience graft-versus-host reactions. The findings of this study help to understand the differential susceptibility of A_f and $C3H_f$ mice to development of tolerance to one another's antigens observed in prior investigations. It appears that, in these mice, the host thymus influences the maturation of the spleen cells from young mice or from neonatally thymectomized mice. However, this influence was often greater in mice given 767 rads than in those given 1046 rads. This differential influence is possibly attributable to irradiation damage to the thymus produced by the higher dose of irradiation. Spleen cells from neonatally thymectomized mice can be differentiated and expanded by the thymus of the host. The differential susceptibility of T_1, early differentiation stages, of thymus-dependent lymphocytes and T_2, late differentiation stages, of thymus-dependent lymphocytes to tolerance induction and immunostimulation, respectively, are proposed as the bases for these otherwise paradoxical influences. (auth)

18986 TRANSPLANTATION OF AUTOIMMUNE POTENTIAL. I. Development of Antinuclear Antibodies in H-2 Histocompatible Recipients of Bone Marrow from New Zealand Black Mice. Morton, J. I.; Siegel, B. V. (Oregon Univ., Portland). Proc. Nat. Acad. Sci. U. S. A.; 71: No. 6, 2162-2165(Jun 1974).

Antinuclear autoantibodies (ANA) appeared in the plasma of lethally irradiated H-2d histocompatible DBA/2 and BALB/c mice several weeks after intravenous transplantation of 2 to 4×10^6 bone marrow cells from 3-week-old animals of the autoimmune New Zealand Black (NZB) strain. Little or no ANA development was observed in DBA/2 or BALB/c strains when syngeneic or nonautoimmune allogeneic marrow was grated, or when NZB marrow was injected into untreated DBA mice or mice receiving 200 rads of x-irradiation. Transfer of 5×10^6 spleen cells from 8-day-old NZB mice into lethally irradiated BALB/c mice effected substantial ANA formation by the ninth day after transfer, compared to a 20-day latency following transfer of the same number of bone marrow cells. This earlier conversion with splenocytes may have been due to the presence of immunocompetent T and B cells, since stem cell numbers of the two tissues were similar. Transplantation of NZB marrow to lethally irradiated H-2 incompatible SJL/J (H-2s) and C57Bl/6 (H-2b) strains brought about less ANA conversion than the transfer of compatible (SJL × NZB)F1 and (C57Bl × NZB(F1 marrow cells to the respective nonautoimmune SJL or C57Bl parental strain. Graft-versus-host reactions thus did not appear to play a requisite or determining role in the autoimmune development observed following grafting of NZB hemopoietic tissues. Reconstitution of lethally irradiated NZB mice with BALB/c or SJL/J bone marrow depressed the recurrence of ANA for 30 days, compared to rapid ANA recovery following NZB marrow injection. The characteristics that ultimately provoke or permit spontaneous auto-reactivity are inherent in the hemopoietic stem cell population of the NZB strain. (auth)

18987 CORRELATION BETWEEN DEOXYRIBONUCLEIC ACID EXCISION-REPAIR AND LIFE-SPAN IN A NUMBER OF MAMMALIAN SPECIES. Hart, R. W.; Setlow, R. B. (Oak Ridge National Lab., TN). Proc. Nat. Acad. Sci. U. S. A.; 71: No. 6, 2169-2173(Jun 1974).

The ability of fibroblasts to perform unscheduled DNA synthesis (a measure of excision-repair) after uv irradiation was measured radioautographically for seven species at several times after several uv fluences. Both the initial rate and the maximum incorporation of [^{3}H]dThd increased with the life-span of the species (shrew, mouse, rat, hamster, cow, elephant, man). Unscheduled DNA synthesis was approximately proportional to the logarithm of life-span. (auth)

18988 EFFECT OF X-IRRADIATION ON THE INTERACTION OF FLASH-EVOKED CORTICAL POTENTIALS AS ASSESSED BY DOUBLE LIGHT FLASH. Daugherty, J. H. Indianapolis; Indiana Univ. (1974). 97p. University Microfilms Order No. 74-13,510. Thesis (Ph. D.).

Double light flashes were used to study the effects of x irradiation on the primary visual pathway in pretrigeminal cats. Computer-averaged evoked cortical responses were recorded on the surface of the dura over the lateral gyrus at flash conditioning-testing intervals of 20 msec from 0 through 200 msec, then at 200 msec intervals through 1000 msec, and finally at 2000 and 3000 msec. Comparison of the evoked cortical responses before and following exposure to x irradiation indicated that changes in the visual response can occur after a 300 R accumulated exposure when double flashes are presented to the eye, even though the response to a single flash may remain unaltered. An inhibition of the primary wave was seen during short conditioning-testing intervals. By alternately conditioning ipsilaterally and contralaterally, a retinal and a lateral geniculate or supraretinal component of the inhibition was discerned. X irradiation was found to increase the retinal inhibitory component and decrease the lateral geniculate or supraretinal inhibitory component. The results are discussed in relation to possibilities of the specific radiation sites being on presynaptic inhibition in the retina and presynaptic disinhibition in the lateral geniculate. (Diss. Abstr. Int., B)

18989 HIGH ENERGY PHOSPHATE COMPOUNDS AND MITOCHONDRIAL FUNCTION IN ISCHEMIC MYOCARDIUM OF SWINE WITH ADVANCED CORONARY ATHEROSCLEROSIS. Skinner, F. P.; Scott, R. F.; Morrison, E. S.; Imai, H.; Jarmolych, J.; Lee, K. T. (Albany Medical Coll.). J. Mol. Cell. Cardiol.; 5: 515-526(Dec 1973).

High energy compounds (adenosine triphosphate and creatine phosphate), lactate and mitochondrial function, and morphology were investigated in swine suffering from persistent myocardial ischemia. The myocardial ischemia was secondary to severe diffuse coronary artery atherosclerosis induced by hypercholesterolemia enhanced by x irradiation to the heart. In the ischemic myocardia, the high energy phosphate compounds were decreased up to 50% and lactate was increased threefold. The ischemia apparently had also damaged myocardial mitochondria; QO_2 and ACR were lower in mitochondrial preparations from the ischemic tissue. In addition, electron microscopy showed more swollen and broken forms in mitochondria preparations from the ischemic myocardium. Hypercholesterolemia alone or irradiation alone to other groups of swine did not induce alterations in QO_2 or ACR, although the percentage recovery of mitochondria was decreased by x-irradiation to the heart. (auth)

18990 RADIORESISTANCE OF SOME BIOLOGIC PROPERTIES OF MOUSE MAST CELLS. Kojima, S.; Ovary, Z. (New York Univ., NY). J. Immunol.; 113: No. 2, 673-676(Aug 1974).

Mast cells taken 11 or 25 days after a sublethal irradiation (540 R) formed rosettes with antibody-coated sheep erythrocytes in the same number as in control non-irradiated mice. The threshold of passive cutaneous anaphylaxis reactions with mouse IgG1 or IgE antibody 2 to 7 days after irradiation was the same in sublethally (540 R), or lethally (780 R), irradiated mice as it was in controls. (auth)

18991 EFFECTS OF LYMPHOCYTES FROM THE THYMUS AND LYMPH NODES ON DIFFERENTIATION OF HEMOPOIETIC SPLEEN COLONIES IN IRRADIATED MICE. Basford, N. L.; Goodman, J. W. (Oak Ridge National Lab., TN). 84: No. 1, 37-48(Aug 1974).

Hemopoietic colonies were counted macroscopically and microscopically in spleens of hybrid mice seven or eight days after they had been irradiated and given parental bone marrow in donor-host combinations exhibiting poor growth. Colonies counted microscopically were classified as to differentiation pathway. Lymphocytes from the thymus or lymph nodes were injected into some recipients at several different dosages and lymphocyte: bone marrow (L:B) ratios. In confirmation of earlier work it was found that thymocytes increased the number and size of colonies in recipients of marrow. A shift of differentiation toward granulopoiesis was also seen when thymocytes were given, although erythropoietic colonies were still the most frequently seen type except at very high L:B ratios. Lymph node lymphocytes shifted the pattern more markedly toward granulopoiesis, even at low L:B ratios. When lymphocytes from either source were given without marrow, only a few colonies could be found in recipients, and if differentiated they were almost exclusively granulopoietic. Irradiation (900 R) of lymphocyte donors reversed the shift so that a normal pattern of differentiation, like that resulting from marrow alone, was seen; irradiated lymphocytes were nonetheless capable of augmenting the size and total number of hemopoietic colonies. (auth)

18992 ERYTHROPOIETIC PROGENITORS CAPABLE OF COLONY FORMATION IN CULTURE: RESPONSE OF NORMAL AND GENETICALLY ANEMIC W/W^v MICE TO MANIPULATIONS OF THE ERYTHRON. Gregory, C. J.; Teppermann, A. D.; McCulloch, E. A.; Till, J. E. (Ontario Cancer Inst., Toronto). 84: No. 1, 1-12(Aug 1974).

Changes in the number and erythropoietin sensitivity of erythropoietic progenitor cells (CFU-E or E) capable of erythropoietin-dependent colony formation in culture have been measured in mice subjected to a variety of manipulations known to affect erythropoiesis. Injection of erythropoietin into mice whose E levels had been reduced by transfusion-induced plethora stimulated a striking increase in this population within 24 hours in both spleen and marrow. Following irradiation and marrow transplantation E were found to regenerate in the spleen with a population doubling time of 6 hours. Evidence of erythropoietin-dependent stimulation of E in vivo under conditions of hemopoietic regeneration was also obtained, although substantial numbers of E were detected in both regenerating spleen and marrow of plethoric mice even without erythropoietin administration. In the same experiments comparable effects of erythropoietin on pluripotent stem cells or the progenitors of granulopoietic colonies in culture were not observed. Detailed studies of the dependence of colony formation on erythropoietin concentration in culture showed variations in erythropoietin sensitivity of E from normal, regenerating and plethoric, erythropoietin-stimulated spleen and marrow. This finding provides the basis for an extremely fine mechanism regulating the flow of erythropoietic differentiation at the level of the production of E. The number of E present in the marrow of untreated W/W^v mice was normal, but their sensitivity to erythropoietin in culture was decreased to a similar extent as E from normal mice exposed to a heightened erythropoietic demand. Plethora had a more marked effect in reducing E numbers in W/W^v mice than in +/+ controls and stimulation of E following subsequent erythropoietin administration was highly defective. The results of these studies provide further evidence that cells identified as E represent a stage of differentiation along the erythropoietic pathway that is several steps removed from pluripotent stem cells and support the view that erythropoiesis, granulopoiesis and stem cell self-renewal are regulated to a major degree by independent mechanisms. (auth)

18993 REAGINIC ANTIBODY FORMATION IN THE MOUSE. IV. Adoptive Anti-Hapten IgE Antibody Response in Irradiated Recipients of Hapten-Primed Cells and Carrier-Specific Cells. Okudaira, H.; Ishizaka, K. (Johns Hopkins University, Baltimore). J. Immunol.; 113: No. 2, 563-573(Aug 1974).

An adoptive transfer system for an IgE anti-hapten antibody response was established in DBA/1 mice with dinitrophenylated ovalbumin (DNP-OA) and keyhole lympet hemocyanin (DNP-KLH) as antigens. Maximal anti-DNP IgE antibody response was obtained by transfer of DNP-primed cells and carrier-specific cells for the secondary carrier to irradiated syngeneic mice, followed by challenge with DNP-secondary carrier conjugate in saline, a procedure which does not induce a primary IgE antibody response. Recipients of hapten-primed cells or carrier-specific cells alone showed meager or no IgE antibody response. Effect of aluminum hydroxide gel (alum) with antigen for carrier immunization and hapten priming was studied by the adoptive transfer technique. It was found that immunization of donors of carrier-specific cells with OA in saline, which did not induce either IgG or IgE antibody response, resulted in a high level of helper function for both IgE and IgG anti-hapten antibody responses in the adoptive response of DNP-KLH-primed cells to DNP-OA. Similarly, addition of a low dose alum with KLH was sufficient for carrier priming for helper function with respect to the anti-DNP IgE antibody response. It was shown, however, that alum had a significant effect on hapten priming. Recipients of the spleen cells from donors primed with DNP-OA or DNP-KLH plus a high dose (1 mg) alum gave much higher anti-hapten IgE antibody response than the recipients of DNP-primed cells obtained by priming with the same protein in saline. Animals primed with DNP-KLH with a low (50 μg) dose alum gave IgG but no IgE secondary response. In spite of the presence of both carrier-specific helper cells and hapten-primed precursors for IgE antibody response, these animals gave rise to a secondary IgG antibody response but failed to show IgE antibody response upon a booster injection with DNP-KLH in saline. If their spleen cells were transferred to irradiated animals, the recipients showed high IgE and low IgG antibody responses upon injection of DNP-KLH in saline. These results suggest that secondary IgE antibody response is enhanced in irradiated recipients. (auth)

18994 EFFECT OF COBALT-60 RADIATION ON THE DENTAL PULPS OF MONKEYS. Gregory, W. B. (Univ. of North Carolina, Chapel Hill). Oral Surg., Oral Med., Oral Pathol.; 38: No. 2, 279-286(Aug 1974).

The maxillary arches of two monkeys were irradiated with ^{60}Co γ in therapeutic doses ranging from 3,000 to 7,013 rads. The pulps of twenty-three permanent teeth extracted periodically were studied microscopically. Four nonirradiated mandibular teeth served as controls, and nineteen maxillary teeth were irradiated at levels approximating 3,000, 5,000, and 7,000 rads as well as 7,000 rads plus 1 month and 7,000 rads plus 2 months. After extraction, the teeth were sectioned and studied microscopically. No histologic differences in the dental tissues due to radiation at any dose level or interval were detected. Gamma radiation in a dose range up to 7,013 rads had no demonstrable adverse effect on the dental pulps of mature permanent teeth of monkeys. (auth)

18995 INDUCTION OF PITUITARY TUMORS IN RATS WITH HEAD X-IRRADIATION AND CASTRATION, AND THEIR CHARACTERIZATIONS BY TRANSPLANTATION. Ro, A. (Hiroshima Univ.); Nishihara, E.; Yokoro, K.; Takizawa, S. Hiroshima Daigaku Genbaku Hoshano Igaku Kenkyusho Nenpo; No. 14, 77-84 (Mar 1974).

Induction of gonadotropic pituitary tumors in rats was attempted by the combined treatment with localized heat x irradiation and castration. Head x irradiation alone increased the incidence of the pituitary tumor (81.8%) remarkably. With addition of castration and/or adrenalectomy in those rats, however, it was markedly decreased to 16 to 22% in female and 6.7% in male rats, and majority of them were microscopic tumors. Histological observation disclosed that prevalence of ectomy cell was noted in the anterior pituitary gland in the castrated rats and most of the microscopic tumors were composed of chromophobic or weakly acidophilic

cells. Transplantation study in one of the two primary tumors revealed that it had mammosomatotropic in character. A unique tumor (W.1106) induced with x ray alone showed predominantly mammotropic function without somatotropic potency. This was contrasted with the typical mammosomatotropic tumor (W.1119) induced with estrogen. (auth)

18996 RADIOPROTECTIVE POTENCY OF THIAZINE AND THIAZOLE DERIVATIVES. Takagi, Y.; Shikita, M.; Akaboshi, S. (National Inst. of Radiological Sciences, Chiba, Japan). J. Radiat. Res.; 15: No. 2, 116-118(Jun 1974).

2-Amino-4, 6, 6-trimethyl-1, 3-thiazine and 2-amino-4-methyl-thiazole demonstrated a radioprotective action in mice irradiated with 700 R of x rays, but did not show any protective action on radiation-induced killing of cultured HeLa cells. Since no evidence of liberation of SH group through ring opening was observed, the protective action of the compound in mice might be due to its pharmacological action. (auth)

18997 CALCULATION OF CHANGES IN BODY TEMPERATURE AND THERMAL INSULATION IN MICE AFTER INTRODUCTION OF RADIOPROTECTIVE SUBSTANCES. Hosek, B.; Novak, L.; Misustova, J. (Ceskoslovenska Akademie Ved, Brno). Biophysics (USSR) (Engl. Transl.); 18: No. 4, 727-733(1973).

The equation for change in the body temperature in mice after introduction of the radioprotectors, cystamine, AET, histamine, and 5-HT, is solved on the assumption of a certain process of changes in heat production for the case of cooling of the organism as a passive body. On the basis of the measured body temperature and heat production the process of changes in time of the effective heat conductivity during the action of the substances introduced is demonstrated. The radioprotectors containing an SH group (AET, cystamine) unlike histamine and 5-HT do not have a considerable influence on the effective heat conductivity and the process of change in body temperature corresponds to passive cooling of the body. Histamine is found to raise the effective heat conductivity by 70 per cent corresponding to its vasodilatatory action; after administration of 5-HT the effective heat conductivity falls by 30 to 40 per cent. The delay in body temperature change in relation to heat production is discussed. (auth)

18998 TRANSPLANTATION OF ALLOGENEIC LYMPHOID CELLS SPECIFICALLY DEPLETED OF GRAFT VERSUS HOST REACTIVE CELLS. Bonavida, B.; Kedar, E. (California Univ., Los Angeles). Nature (London); 249: No. 5458, 658-659(14 Jun 1974).

Experimental work is described that shows that fractionated allogeneic mouse spleen cells inoculated into lethally irradiated recipients permit the host to recover from the combined effects of irradiation and GvH (graft versus host) disease. It also shows that a specific component of immunocompetent GvH reactive cells can be depleted from a normal spleen lymphoid cell preparation by adsorption on allogeneic cell monolayers. It is suggested that the techniques used in these studies might be applied in bone marrow transplantations, immunodeficiency diseases, and immunotherapy of cancer. (UK)

18999 REACTIVITY OF IRRADIATED ORGANISM TO ANALGESICS. Kovalcik, V.; Zabojnikova, M. (Cominius Univ., Bratislava). Folia Fac. Med. Univ. Comenianae Bratislav.; 10: No. 2, 183-229(1972). (In Slovak).

The efficiency of analgesics, both narcotic and nonnarcotic, was studied in whole-body x-irradiated mice and rats to find whether or not the reactivity of the organism to analgesics changes as a result of irradiation. Investigated were morphine, pethidine, and methadone as typical narcotics, and aminopyrine as a typical nonnarcotic analgesic. In various tests carried out at various intervals following exposure, the assumption was confirmed that irradiation does not significantly affect the efficiency of the analgesics studied, as the reactivity changes of the irradiated organisms were not statistically significant. (Nuclear Sci. Abstr. Czech.)

19000 MODIFICATION OF THE PROLIFERATIVE CAPACITY OF TRANSPLANTED BONE MARROW COLONY FORMING UNITS BY CHANGES IN THE HOST ENVIRONMENT. Beran, M.; Tribukait, B. (Karolinska Institutet, Stockholm). 84: No. 1, 57-68 (Aug 1974).

Regulation of the proliferation of transplanted colony forming-units (CFUs) was investigated in lethally irradiated mice, pretreated by methods known to accelerate hemopoietic recovery after sublethal irradiation. Prospective recipients were exposed to either hypoxia, vinblastine or priming irradiation and at different intervals thereafter lethally irradiated and transplanted with bone marrow. Repopulation of CFUs was determined by counting the number of splenic colonies in primary recipients or by retransplantation. Regeneration of grafted CFUs was greatly accelerated and their self-renewal capacity increased in mice grafted within two days after hypoxia. Also the number of splenic colonies formed by grafted syngeneic CFUs as well as by C57BL parent CFUs growing in BC3F1 hosts was significantly increased. The effect was not dependent on the seeding efficiency of CFUs and apparently resulted from hypoxia induced changes in the hosts physiological environment. Proliferative capacity of grafted CFUs increased remarkably in hosts receiving vinblastine two or four days prior to irradiation. Priming irradiation given six days before main irradiation accelerated, given two days before impaired regeneration of CFUs. The increased rate of regeneration was not related to the cellularity of hemopoietic organs at the time of transplantation. The growth of CFUs in diffusion chambers implanted into posthypoxic mice was only slightly improved which does indicate that the accelerated regeneration of CFUs in post-hypoxic mice is mainly due to the changes in the hemopoietic microenvironment. A short conditioning of transplanted CFUs by host factor(s) was sufficient to improve regeneration. The results might suggest that the speed of hemopoietic regeneration depends on the number of CFUs being induced to proliferate shortly after irradiation, rather than on the absolute numbers of CFUs available to the organism. (auth)

19001 FREQUENCY OF X-RAY INDUCED DOMINANT LETHALS IN MICE OF DIFFERENT STRAINS. Domareva, O. P.; Suvorova, E. A. (Inst. of Evolutionary Morphology and Ecology of Animals, Moscow). Genetika; 10: No. 5, 44-51(May 1974). (In Russian).

Data on the effect of different x-ray doses on the frequency of dominant lethals in mice of different strains, viz. C57Bl, A/HeJ, BALB/c, are presented. Males at an age of 3 to 4 months were x-irradiated at different doses: 100, 200, and 400 R and were subsequently mated with females immediately after irradiation and after a 15 days' interval. Thus the egg-cells of females were fertilized by sperms irradiated both at the stage of mature spermatozoa and at the spermatid stage. Among the three strains studied the highest frequency of x-ray induced dominant lethals was observed in the strain BALB/c, while the lowest frequency was recorded in the strain C57Bl. The frequency of induced dominant lethals was higher in case of irradiation of spermatids, than in case of irradiation of mature spermatozoa. On the basis of the analysis of the data obtained on the induced dominant lethals in different strains of mice a correlation was observed between general and genetic radiosensitivity, while no correlation was observed between the frequency of spontaneous and induced lethal mutations. (auth)

19002 THE RADIOSENSITIZING EFFECT OF OZONE IN THE ANIMAL EXPERIMENT. Hernuss, P.; Mueller-Tyl, E.; Seitz, W. (Vienna Univ. (Austria). 1. Frauenklinik; Vienna Univ. (Austria). 2. Frauenklink; Vienna Univ. (Austria). Strahlentherapeutische Klinik; Vienna Univ. (Austria). Inst. fuer Klinische Strahlenbiologie). Strahlentherapie; 147: No. 1, 91-96(Jan 1974). (In German).

From 54th meeting of the Deutsche Roentgengesellschaft and 13th meeting of the Oesterreichische Roentgengesellschaft; Vienna, Austria (12 Apr 1973). 4 figs.; 1 tab.; 14 refs.

Results are given of the comparison of radiotherapy alone or a combination of radiotherapy with treatment using an ozone-oxygen mixture for the treatment of the Walker carcinosarcoma of the rat. The combined therapy brought significantly better results than the radiotherapy alone. It is not yet sure whether different modes of application and dosage influence the results. Following the application of 2,800 rd TD, macroscopic tumor remission in 39% of the animals with combined treatment was observed; in contrast, the tumor remained demonstrable in all the animals treated with radiotherapy alone at equal doses. Six months after the onset of therapy, 9 of 52 treated animals are still alive without recurrences and metastases. (auth)

19003 INFLUENCE OF X RAYS ON THE ELECTROLYTE SHIFTS AND ON THE MYOCARDIAL METABOLISM. P. 3. Radiation-Induced Changes in Magnesium Concentration in Isolated Atria of Guinea Pigs. Prignitz, R.; Hoffmeister, G. (Marburg Univ. (F. R. Germany). Klinik und Poliklinik fuer Strahlentherapie und Roentgendiagnostik). Strahlentherapie; 146: No. 6, 693-700(Dec 1973). (In German).

1 fig.; 4 tabs.; 46 refs.

The reaction of cellular magnesium on local irradiation (1,000 up to 10,000 R) was examined on isolated left and right atria of guinea pigs after electric stimulation and in rest. The magnesium content of the myocardial tissue significantly declines following irradiation. Moreover, the extracellular space augments in correlation to the dose. (auth)

19004 INDUCIBILITY OF AN INCREASED BIOLOGICAL RADIORESISTANCE BY CHEMICAL SUBSTANCES ON FAST NEUTRON IRRADIATION. Langendorff, H.; Langendorff, M.; Moenig, H. (Heiligenberg-Institut (F. R. Germany); Freiburg Univ. (F. R. Germany). Inst. fuer Biophysik und Strahlenbiologie).

Strahlentherapie; 147: No. 1, 69-76(Jan 1974). (In German).
5 tabs.; 13 refs.

The effectiveness of thiophosphate WR 2721 was tested for its ability to protect NMRI mice against radioinduced mortality after irradiation with fast neutrons of 14.7 MeV. A dose reduction factor (DRF) of 1.17 ± 0.02 was calculated by determination of the survival rate at $LD_{50/30d}$. The low effectiveness of the radioprotective agent, compared with that obtained after an irradiation with x rays (DRF of 2.20), is attributed mainly to the difference in the affinity of this substance between the intestinal tissue and the bone marrow. (auth)

Invertebrates

Refer also to abstract 18895.

19005 EFFECTS OF X RAYS ON THE SURVIVAL PERIOD IN THE COMPLETE ABSENCE OF FOOD OF CERATITIS CAPITATA WIED. Carante, J. P. (Univ., Lyon). Compt. Rend., Ser. D; 278: No. 3, 373-376(14 Jan 1974). (In French).

Studies of adult ceratitis exposed at the termination of their pupal lives to 1000, 2000, and 3000 R of x-radiation demonstrated that the complete sterilization of the females induces an increased resistance to fasting insects. The most probable explanation of this phenomenon is associated with the liaising of metabolic modifications of the adipose body. (FR)

19006 MODIFICATIONS TO THE SURFACE ULTRASTRUCTURAL CHARACTERISTICS OF CERATITIS CAPITATA LARVA CUTICULES DURING THE PUPARIUM FORMATION; EFFECT OF γ RADIATION AND β ECDYSONE ON THIS CUTICULAR MORPHOGENESIS. Cals-Usciati, J. (Univ., Paris). Compt. Rend., Ser. D; 278: No. 1, 65-68(2 Jan 1974). (In French).

Scanning electron microscope observations revealed surface ultrastructural modifications in the cuticules of larvas in the third Ceratitis capitata stage. Gamma irradiation arrests these modifications; a hormone treatment (β ecdysone injections) induces an increase in this inhibition of the activity of epidermic cells. (FR)

19007 METABOLIC ASPECTS OF DOSE-FRACTIONATION RECOVERY IN TENEBRIONID INSECTS. Griffiths, T. D. Urbana, IL; Univ. of Illinois (1973). 134p. University Microfilms Order No. 74-12,028.

Thesis (Ph. D.).

Tenebrionid insects exhibit typical dose-fractionation recovery. When a 50 to 99% lethal exposure of x rays is split into two equal fractions, survival increases and reaches a peak as the interval between the exposures increases to around 6 hours, declines slightly as the interval increases to 8 hours, and slowly increases again with longer interfraction intervals. This response is temperature sensitive with recovery occurring at slower rates at lower temperatures. The influence of temperature suggested a metabolic role for recovery. In the studies reported here, possible metabolic requirements of dose-fractionation recovery in Tenebrionid insects were studied. Ingestion by larval or adult Tribolium of various respiratory, nucleic acid or mitochondrial inhibitors did not alter dose-fractionation recovery. The inhibitors used were potassium cyanide, sodium azide, rotenone, sodium arsenate, lead acetate, crystal violet, ethidium bromide, acriflavin, caffeine, ouabain, chloroquine, and quinacrine. Injection of sublethal concentrations of sodium arsenate, potassium cyanide, ouabain, and caffeine failed to inhibit dose-fractionation recovery in Tenebrio molitor larvae. Placing Tenebrionid insects in 100% nitrogen for the entire interval between fractionated exposures of x rays completely inhibited recovery. This was seen in Tribolium castaneum larvae, T. confusum Oklahoma larvae and adults, T. confusum McGill Black larvae and adults, and Tenebrio molitor larvae. This inhibitory effect of hypoxia was reversible. If insects were placed in nitrogen immediately following an initial exposure of irradiation, significant recovery could still be detected if the insects were placed in air for at least 2 hours before the second exposure. The total amount of recovery was dependent on the total length of time insects were placed in air rather than on the total amount of oxygen present. In experiments where insects were placed in gas mixtures containing nitrogen and small amounts of air (45 to 270 μMO_2) between fractionated exposures, there was virtually complete recovery. Because dose-fractionation recovery requires only small amounts of oxygen and because recovery begins as soon as oxygen is added and is inhibited as soon as oxygen is removed, oxygen may act as a co-factor for some repair enzyme. Hypoxia also alters the single-dose response of Tenebrionid insects. Placing larvae in nitrogen for at least 6 hours following irradiation and placing adults in hypoxia for at least 6 hours to irradiation results in higher lethality following single exposures of x rays. The effect of hypoxia on dose-fractionation recovery was examined to determine how this effect on single doses altered dose-fractionation survival. Many different patterns of hypoxic treatments were employed before, between, and after fractionated exposures, and although survival values were altered by hypoxia before the first and after the second exposure, these effects were relatively small compared to the complete suppression of recovery by hypoxia during the entire interfraction interval. (Diss. Abstr. Int., B)

19008 PUPARIUM FORMATION IN THE FLESHFLY, SARCOPHAGA BULLATA P. I. Effects of Proteinaceous Factors Present in the Hemolymph and the CNS of the Larva. II. Effect of X-Irradiation. Sivasubramanian, P. Urbana, IL; Univ. of Illinois (1973). 121p. University Microfilms Order No. 74-12,191.

Thesis (Ph. D.).

Injection of hemolymph from orange puparia or of CNS extracts from larvae into red-spiracle larvae of Sarcophaga bullata accelerates retraction of anterior segments and tanning, two of several morphogenetic processes that occur during pupariation in cyclorrhaphous flies. Based on the similarities in the nature of two proteinaceous factors released in hemolymph and CNS it is suggested that they originate in the CNS, are stored in peripheral nerve endings and released through the action of ecdysone into the hemolymph during pupariation. The factors are inactive in the pre-critical (36 hours before pupariation) and early post-critical (10 to 12 hours before pupariation) stage larvae. This suggested that the factors cannot replace ecdysone in effecting pupariation, and that they probably require ecdysone-dependent enzyme proteins or other co-factors which become available only in the red-spiracle larva. Post-feeding, pre-critical stage larvae (36 hours before pupariation) of Sarcophaga bullata were exposed to x rays and the effects on pupariation observed. With doses ranging from 1250 R to 10,000 R the prepupurial period was prolonged and the duration of this delay increased with higher doses. Doses above 2500 R inhibited the retraction of anterior segments, longitudinal contraction, and cuticular shrinkage causing the formation of larval-like tanned puparia. When the anterior part of the body containing the brain-ring gland complex was shielded during irradiation normal puparia were formed after still a delay, the extent of which was proportional to the body area irradiated. Injection of β-ecdysone counteracted this delay. However, the puparia were larval-like whenever the part containing the CNS was irradiated. With the doses used, irradiation had no effect on post-critical stage larvae. This suggested that the CNS has a special mechanism, probably neurosecretory in nature which directly controls the neuro-muscular processes of pupariation, and when this mechanism is damaged by irradiation larval-like puparia are formed. The pupariation delay was attributed to a temporary block in the synthesis, or release, or both of α-ecdysone (in whole-body or anterior-only irradiated larvae) and its final conversion to β-ecdysone (in posterior-only irradiated larvae). The fact that post-critical stage larvae are insensitive to irradiation suggests that the neuro-muscular and neuro-secretory processes which are affected by irradiation are already completed at that stage. A comprehensive model has been proposed which accounts for the role of ecdysone and the proteinaceous factors in the various processes that occur during pupariation. (Diss. Abstr. Int., B)

19009 PERSISTENCE OF CHROMOSOME BREAKS IN DIFFERENT STAGES OF SPERMATOGENESIS OF DROSOPHILA. Sobels, F. H. (State Univ., Leiden). Mutat. Res.; 23: No. 3, 361-368(Jun 1974).

To determine whether chromosome breaks produced in spermatids and spermatocytes remain open until after fertilization, fractionation experiments with pupae of different ages were carried out. In a first series of experiments the first fraction of 500 R x-irradiation was given to 0-, 24-, or 48-h-old pupae, and the second fraction of 1000 R to inseminated females, i.e., to the same cells after they had developed into mature spermatozoa. Simultaneously, appropriate control experiments with irradiation of the pupae or inseminated females alone were carried out. The translocation yield obtained in the fractionated group was then compared with that expected on the basis of additivity or interaction between breaks produced by the single fractions. The results show that in the 0-h pupal series, the translocation yields fall somewhat short of additivity; in the 24-h series, the frequency of translocations did not deviate from additivity; in the 48-h series there was good evidence for interaction of breaks. In a second set of experiments, the pupae received either a total exposure of 800 R delivered in two equal fractions, the first one when they were 24 or 36 h old, and the second when they were, respectively, 32 or 45 h old; or a single exposure of 400 R when 24, 32, 36 or 45 h old. From the yield of translocations obtained with the latter regime, the frequencies expected on the basis of additivity (and interaction) were computed and compared with those actually observed with regime. It was found that when the first fraction is given to 24-h-old pupae, the translocation yields are entirely consistent with the expectation based on additivity;

when the first fraction was given to 36-h-old pupae, the yield conformed to interaction. Transition from additivity to interaction of breaks thus occurs between 24 and 36 h of pupal age. A comparison of the translocation frequencies induced by single 400 R exposures in pupae of different ages, from cultures with controlled population density, revealed that spermatids in 24-h-old pupae are characterized by peak sensitivity to x-irradiation. (auth)

19010 COMPARATIVE STUDY OF SEVERAL STRAINS OF THE TETRANYCHUS NEOCALEDONICUS COMPLEX AND STERILIZATION TESTS OF MALES BY X RAYS. Gutierrez, J. (Centre ORSTOM, Tananarive, Madagascar); van Zon, A. Q. Entomol. Exp. Appl.; 16: No. 1, 123-134(1973).

Five populations of Tetranychus neocaledonicus, collected in various biotopes from different plants, were studied in order to become informed about variation in this species. It appeared that all strains differed with respect to longevity and fecundity. Crossings resulted in incompatibility, hybrid inviability, hybrid sterility, and hybrid breakdown. It is suggested that the great interpopulational variation as found in T. neocaledonicus is a consequence of the haplo-diploid system. An important difference in longevity and fecundity between mated and unmated females has been stated for all strains. Outcrosses with males from another species indicated that it is not the fertilization, but the insemination only which induces the enhanced fecundity in T. neocaledonicus. Irradiated males appeared to be able to inseminate females effectively, resulting in the prevention of viable diploid offspring. (INIS)

19011 EFFECTS OF CAFFEINE ON MITOTIC DELAY OF SEA URCHIN EGGS FERTILIZED WITH X-IRRADIATED SPERM. Kimura, H. (Tokyo Univ.). J. Radiat. Res.; 15: No. 2, 75-80 (Jun 1974).

When sea urchin eggs were fertilized with x-irradiated sperm, the prolongation of streak stage in the first cleavage was induced. Caffeine reduced the prolonged streak stage only when the chemical was administered during the period of the prolongation. This effect of caffeine was observed at the concentrations higher than 0.13 mM and reached the maximum at approximately 2 mM. Other methylxanthines such as theophylline and theobromine, which are generally known to increase c-AMP contents in the cell, exhibited similar effects upon the mitotic delay. On the other hand, aminophylline which is also considered to increase c-AMP level in sea urchin eggs, had not such effect. (auth)

19012 "INDENT" FORMATION AND MITOTIC DELAY OF SEA URCHIN EGGS FERTILIZED WITH X-IRRADIATED SPERMS. Nakamura, I. (Tokyo Univ.). J. Radiat. Res.; 15: No. 2, 111-113 (Jun 1974).

When eggs of the sea urchin, Clypeaster japonicus, was fertilized with sperm irradiated with 4 kR x rays, the first cleavage was delayed about 30 min. In addition, the disappearance of the indent and the end of the streak stage (marked by the disappearance of the nuclear membrane) were delayed by the same length as the first cleavage. From these observations, it is apparent that division delay induced by the irradiation is due to the prolongation of the streak stage. (auth)

19013 γ-RADIATION APPLICATION IN THE CONTROL OF INSECT PESTS IN AGRICULTURAL PLANTS. Andreev, S. V.; Martens, B. K.; Molchanova, V. A.; Krymov, V. V. pp 89-95 of Primenenie Izotopov i Yadernykh Izluchenii v Sel'skom Khozyaistve. I. Moscow; Atomizdat (1971). (In Russian).

A study was made of the use of the method of radiation sterilization of insects in pest control programs. Studies were made on fruit pests (Mediterranean fly, fruit fly, melon fly, and lesser apple worm) and also on soil, vegetable, and grain pests. Gamma sources (^{60}Co and ^{137}Cs) were used. The optimum doses necessary for the radiosterilization of the various insects were determined. Special attention was given to the development of sterilization methods in connection with the possibility of its wide utilization in pest control with agricultural plants. (tr-auth)

Radionuclide Effects (Internal Source)

Man

Refer also to abstracts 18363, 18615, 18617, 18618, and 19026.

19014 169Yb-DTPA CISTERNOGRAPHY: HOW MANY RADS DOES THE BRAIN RECEIVE. Alazraki, N.; Hurwitz, S.; Halpern, S. E.; Ashburn, W. L. (Veteran's Administration Hospital, San Diego, CA). J. Nucl. Med.; 15: No. 7, 643-644(Jul 1974).

A chromatographic examination of the brain was made using ^{169}Yb-DTPA. There was no free Yb contamination. A few patients, previously studied with ^{169}Yb-DTPA cisternography, were reimaged without administration of more radiopharmaceutical. In varying periods up to 38 days after the intrathecal administration of hyperbaric ^{169}Yb-DTPA, 3.8 to 11.4% residual activity was detected in the head compared with counts seen at 24 hr. (HLW)

19015 KINETICS OF LARGE THERAPY DOSES OF ^{131}I IN PATIENTS WITH THYROID CANCER. Singh, B.; Sharma, S. M.; Patel, M. C.; Raghavendran, K. V.; Berman, M. (Tata Memorial Hospital, Bombay). J. Nucl. Med.; 15: No. 8, 674-678(Aug 1974).

Radioiodine kinetics were studied in 16 thyroid carcinoma patients treated with a postsurgery ablation dose of ^{131}I ranging from 90 to 450 mCi. The data obtained from serial whole-body radioactivity measurements, thyroid uptakes, plasma radioactivity, and protein-bound iodine radioactivity measurements in the patients could be fitted to the Brownell model which was modified to simulate an unsteady state by varying the turnover rates between thyroid and plasma compartments. Although there appears to be a linear relationship between the radiation dose delivered to the thyroid and the maximal radioiodine concentration, there is a change in the slope beyond ^{131}I concentration of 0.4 mCi/gm of thyroid tissue. More data with higher radioiodine doses are necessary to confirm a saturation effect. (auth)

Animals

Refer also to abstracts 18648, 18925, 18968, 19028, and 19029.

Microorganisms

19016 INDUCTION OF MUTATIONS IN ESCHERICHIA COLI BY DECAY OF INCORPORATED ^{35}S. Pluciennik, H. (Univ., Warsaw). Acta Microbiol. Pol., Ser. A; 6: No. 2, 187-196.

The lethal effect and reversion to prototrophy of try and leu markers in Escherichia coli, induced by decay of incorporated ^{35}S, were investigated. The lethal efficiency of transmutation $^{35}S \rightarrow {}^{35}Cl$ was 2.4×10^{-3} at about +4° and 8.6×10^{-4} at -196°. No $try^- \rightarrow try^+$ reversions appeared. Reversions $leu^- \rightarrow leu^+$ were induced with an efficiency of 5×10^{-11} per one ^{35}S decay at about +4°, and of 2.5×10^{-10} per one ^{35}S decay at -196°. (auth)

Nuclide Kinetics and Toxicology

Man

Refer also to abstracts 18355, 18363, 18619, 19014, 19015, 19055, 19065, 19088-19090, and 19108.

19017 (SZS-148, pp 57-61) METABOLISM OF IODINE ISOTOPES IN THE HUMAN ORGANISM AIMED AT ESTABLISHING AND IMPROVING RADIATION PROTECTION STANDARDS. Arkhangelbskaya, G. V.; Zvonova, I. A.; Likhtarev, I. A.; Shamov, V. P.; Shteper, L. M. Mar 1973. (In Russian).

From German-Soviet working meeting on the question of radiation protection; Berlin, Germany (8 June 1972).

Multicompartment models are essential for theoretical, experimental and dynamic studies on the metabolism of radioiodine. The individual compartments are organic and inorganic iodine compounds in the thyroid and nonthyroid tissue which are used in various combinations. Experiments with human subjects gave the values for loading of the individual compartments and for the transfer factors. From this, new values for maximum permissible annual intake and maximum permissible concentration for occupationally exposed personnel and individual groups of the population are derived. The values contained in the existing national and international recommendations do not reflect correctly the geographic and national peculiarities of the USSR. For long-lived iodine isotopes the values are lower by a factor of 1.5 to 2, whereas for short-lived they are higher by a factor of 2 to 4 than those recommended. (auth)

19018 METHOD OF THE LEAST SQUARES ON A COMPUTER FOR γ-SPECYROSCOPY OF γ RADIATION OF THE HUMAN BODY. Belle, Yu. S.; Kovtun, A. N.; Lebedev, O. V.; Moroz, G. L. Med. Radiol.; 19: No. 5, 75-78(May 1974). (In Russian).

A program written in ALGOL-60 was formulated for the computer processing of γ spectra obtained during the measurement of the radioactivity of patients. The program was verified by processing of the spectra from the isotopes ^{137}Cs, ^{40}K, and ^{60}Co in a phantom in chair geometry. (JSR)

19019 PROOF OF INCREASED AMOUNT OF URANIUM IN THE RED BLOOD CELLS OF VENOUS BLOOD IN URANIUM MINERS. Nosek, J.; Simkova, M.; Kukula, F.; Pehr, F.; Kubat, M. Prac. Lek.; 26: No. 4, 124-127(Apr 1974). (In Czech).

Uranium contents were determined in the dry substance of washed red blood cells of venous blood in uranium miners by

neutron activation analysis. They ascertained in persons not working in the presence of uranium hazards (the control group) in the dry substance of red blood cells a mean of 0.4 ± 2.5 ppB uranium. In persons exposed to uranium (uranium miners), significantly more uranium was found in the dry substance of red blood cells than in the control group. The increased content of uranium in the dry substance of red blood cells of the miners is directly related to the number of years of uninterrupted work of the miners in their occupation. This group of data is a linear regression group. (auth)

19020 MEASUREMENT OF MYOCARDIAL UPTAKE USING EXTERNAL DETECTION. de Vernejoul, P. (Hopital Necker-Enfants-Malades, Paris); Fauchet, M.; Agnely, J.; Mestan, J. Compt. Rend., Ser. D; 278: No. 7, 979-981(11 Feb 1974). (In French).

Measurements were effected on the uptake of ^{131}Cs by the myocardium. In this way, a quantitative evaluation was made of the functional state of the myocardial cell. Certain precautions must be exercized (due to the nature of ^{131}Cs), if measurements are to be obtained which will permit the results to be expressed as a % of the injected dose per 100 grams of myocardium. Preliminary results are presented. (FR)

19021 SIGNIFICANCE OF THE LIVER–SPLEEN UPTAKE RATIO IN LIVER SCANNING. Wilson, G. A.; Keyes, J. W. Jr. (Univ. of Michigan, Ann Arbor). J. Nucl. Med.; 15: No. 7, 593-597(Jul 1974).

The use of a simple criterion for assessing the relative uptake of colloid in the liver and spleen was evaluated in a series of patients unselected for type of diagnosis. Categorization of liver scans into groups showing equal, increased, or decreased relative splenic uptake provides useful differential diagnostic information. Increased splenic uptake was seen most commonly in cirrhosis, carcinoma, and diabetes mellitus. Decreased uptake was seen in RES malignancies. No association with anemia alone was found. (auth)

19022 RAPID METHOD FOR MEASUREMENT OF FRACTIONAL INTESTINAL ABSORPTION OF CALCIUM. Chanard, J.; Assailly, J.; Bader, C.; Funck-Brentano, J. L. (Hopital Necker, Paris). J. Nucl. Med.; 15: No. 7, 588-592(Jul 1974).

A single method for fractional intestinal calcium absorption (FCaA) measurement on plasma samples is proposed. FCaA is measured within a time interval of less than 8 hr using only one isotope successively injected intravenously and ingested 2 hr later. Assuming that plasma disappearance of the intravenously administered dose is identical to that of the absorbed oral dose it was verified that: the absorption of the radioactive oral dose was achieved within 4 hr, the log curve of plasma radioactivity obtained after total absorption of the oral dose is a straight line parallel to that obtained after the intravenous dose. This corresponds to the exchangeable calcium expanding pool model. FCaA was measured in 60 subjects. FCaA was 58.9% ±3.7 (mean ± sem) in controls, 90.7% ±4.7 in primary hyperparathyroidism, 79.3% ±4.8 in idiopathic hypercalciuria, 81% in Paget's disease, and 35.8% ±2.6 ($p < 0.001$) in chronic renal failure treated conservatively. Following hemodialysis FCaA was transiently increased to 50.6% ±2.5 ($p < 0.001$) when performed 10 to 12 hr after the hemodialysis run (calcium dialysate concentration = 7 mg%). (auth)

19023 LACRIMAL GLAND ACCUMULATION OF ^{67}Ga. Mishkin, F. S.; Maynard, W. P. (Martin Luther King Jr. General Hospital, Los Angeles). J. Nucl. Med.; 15: No. 7, 630-631(Jul 1974).

In two patients with increased tear production there was increased lacrimal gland accumulation of ^{67}Ga-citrate. Gallium-67 tear activity could not be identified in five patients who had no visualization of the lacrimal glands whereas it could be detected in three patients with induced lacrimation. This activity upon radiochromatography migrated like the serum transferrin. These findings suggest that the gallium is bound to transferrin in the tears and accumulates in relationship to function. In the presence of lacrimal gland visualization, activity in the nasopharynx should be interpreted with caution. (auth)

19024 RENAL UPTAKE OF ^{99m}Tc-SULFUR COLLOID. Higgins, C. B.; Taketa, R. M.; Taylor, A.; Halperan, S. E.; Ashburn, W. L. (Univ. of California, San Diego). J. Nucl. Med.; 15: No. 7, 564-566(Jul 1974).

Accumulation of ^{99m}Tc sulfur colloid by the kidneys was observed in two patients with congestive heart failure. In one instance renal uptake of ^{67}Ga-citrate was also observed. (auth)

Animals

Refer also to abstracts 19054 and 19109.

19025 (COO-3167-101) PHASE I. RADIATION AND RADIOISOTOPE STUDIES WITH LABORATORY AND DOMESTIC ANIMALS. Subsection. Physiological Studies of Environmental Pollutants. Progress report, June 1, 1973–May 31, 1974. Lengemann, F. W. (Pennsylvania State Univ., University Park (USA)). 1974. Contract AT(11-1)-3167. 104p. Dep. NTIS $8.25.

Results are reported from studies of the tissue distribution of ingested or injected ^{131}I, ^{141}Ce, and ^{47}Ca leading to excretion in milk of cows and goats. The effects of perchlorate ingestion on the secretion of ^{123}I in milk were also studied. Studies on ^{203}Hg distribution following oral or intravenous administration to lactating goats as $^{203}HgCl_2$ showed that Hg is poorly absorbed and only a small fraction is transferred to milk. Mechanisms for radionuclide transfer across mammary epithelium were studied in guinea pigs. The reliability of external monitoring of the mammary gland as a measure of radionuclide content of milk was also investigated. Methods for the estimation of milk volume using ^{141}Ce as a tracer for isotopic dilution studies were also investigated. (CH)

19026 (SZS-148) GERMAN–SOVIET WORKING MEETING ON THE QUESTION OF RADIATION PROTECTION, BERLIN, 8–9 JUNE 1972. (Staatliche Zentrale fuer Strahlenschutz, Berlin (German Democratic Republic)). Mar 1973. 148p. (In several languages). (CONF-7206102-).

Separate abstracts were prepared for each of the 15 papers presented. (MCG)

For abstracts of individual papers see: 18619, 18628, 18640, 18676, 18701, 18702, 18909–18912, 19017, and 19027–19030.

19027 (SZS-148, pp 1-10) METABOLISM AND DECORPORATION OF PROMETHIUM AFTER INHALATION AND INGESTION OF Pm-147-CONTAINING SUBSTANCES. Gensicke, F.; Hoelzer, F. Mar 1973. (In German).

From German–Soviet working meeting on the question of radiation protection; Berlin, Germany (8 June 1972).

The distribution and microdistribution of ^{147}Pm in mice was assessed after inhalation or ingestion of $^{147}PmCl_3$ and ^{147}Pm containing luminous masses. Lung and whole-body clearance occurred in several phases. In the 2nd and 3rd phase of lung clearance the biological half-life of luminous masses is two to three times that of $PmCl_3$. Studies on decorporation were performed with hexametaphosphate, EDTA, and DTPA. Between the 1st and 28th day after inhalation of $PmCl_3$ hexametaphosphate aerosols caused a decrease in lung deposition of 77 percent. The treatment of inhaled luminous masses with DTPA or EDTA resulted in a 55 to 80 percent reduction of the activity concentration in the lung after 15 days. The effect of polyaminopolycarboxylic acid after inhalation of ^{147}Pm containing luminous masses is higher than that of hexametaphosphate. No effect could be observed with regard to the activity contained in intact macrophages. (auth)

19028 (SZS-148, pp 12-28) METABOLIC BEHAVIOUR AND BIOLOGICAL EFFECTS OF NEPTUNIUM-237. Moskalev, Yu. I.; Rudnitskaya, E. I.; Zalikin, G. A.; Petrovich, I. K.; Levdik, T. I. Mar 1973. (In Russian).

From German–Soviet working meeting on the question of radiation protection; Berlin, Germany (8 June 1972).

In experiments with white rats metabolic behavior of ^{237}Np and the effects of different doses on life span, weight, peripheral blood, and the morphological changes in the organs were studied. After intratracheal application ^{237}Np is slowly eliminated from the lungs. After one day 80% and after 32 days 58.6% of the introduced quantity were measured. The lung clearance is described by a binomial exponential function. Thirty-one % was excreted with a biological half-life of 4 days and 69% with 133 days. After intratracheal uptake the relative content of ^{237}Np in the skeleton was 1.5 to 3.3 times higher, and in the liver 7.5 to 5.0 times less than after intravenous application. The results of the experiments on biological effects of ^{237}Np nitrate showed a very high chemical toxicity. After application of the nuclide in doses of 0.005, 0.0025, 0.001 and 0.0005 μCl Np/g one part of the animals died during the first three to six days. The higher the dose of ^{237}Np, the higher the percentage of animals that died after injection. The mean survival time of rats that survived the toxic period is insignificantly shortened in comparison with the controls (492 ± 57) and amounts to 332 ± 31, 412 ± 44, 431 ± 57 and 396 ± 73 days ($P = 0.05$). The calculation of LD_{50} for 7 and 30 days gives the same value of 0.00295 μCl/g. The subacute ($LD_{50/240}$) and chronic doses ($LD_{50/360}$) were 0.00193 and 0.00138 μCl ^{237}Np/g respectively. A comparison of the acute doses ($LD_{50/30}$) shows the high toxicity of ^{237}Np which is 24 times that of ^{239}Pu and 37 times that of ^{241}Am. The effective chronic doses differ only a little. Long time after the uptake of ^{237}Np the chemical toxicity no longer prevails, so that late effects must be attributed to radiation. At late times the whole spectrum of pathological processes of radiation damage is observed. Osteosarcomas are

already caused by relatively low radiation doses (about 4 rad). (auth)

19029 (SZS-148, pp 29-50) METABOLISM AND BIOLOGICAL EFFECTS OF PROMETHIUM-147. Burykina, L. N.; Vasilbeva, L. A.; Zhanadilov, Sh.; Lyarskii, P. P.; Ponomareva, V. L. Mar 1973. (In Russian).

From German-Soviet working meeting on the question of radiation protection; Berlin, Germany (8 June 1972).

The metabolism of promethium-147 after intratracheal application in rats of different age (1 and 2.5 months) was studied. The half-life of the radionuclide with regard to its excretion from the lungs, liver and skeleton was determined and it was observed that the excretion from soft tissues of young rats occurred more intensively than from adult animals. The results of studies on the acceleration of the excretion of promethium with intratracheally administered pentazin ($CaNa_3DTPA$) are presented in dependence on the time elapsed between incorporation of the radionuclide and uptake of the chelating agent as well as the mode of incorporation (single or repeated uptake). Furthermore the radiotoxicity of promethium-147 after intratracheal application of 40; 20; 5; 2.5 and 1 $\mu Ci/g$ was studied. New results on the combined effects of promethium-147 and external gamma irradiation were obtained. The combined effects are discussed on the basis of clinical, hematological, and histological criteria. (auth)

19030 (SZS-148, pp 51-56) INFLUENCE OF DTPA ON THE ACCELERATION OF ^{241}Am EXCRETION AFTER CHRONIC INTAKE BY RAT. Zalikin, G. A.; Popov, B. A. Mar 1973. (In Russian).

From German-Soviet working meeting on the question of radiation protection; Berlin, Germany (8 June 1972).

Albino rats were daily given a subcutaneous injection of 0.0025 μCi ^{241}Am (pH 3) for 200 days. After this time the rats were divided into 3 groups: the first group further on received the radionuclide, the second was treated with pentazin (DTPA) for 100 days, and the third served as control group. Without DTPA treatment ^{241}Am was mainly excreted via feces. The ratio of Am in urine and feces was 1:5. In comparison with the controls pentazin increased the urinary excretion of ^{241}Am during the first 10 days by a factor of 10 and through the subsequent 10 days by a factor of 5. Later the urinary excretion of the nuclide in the experimental group was twice that in the control group. During the first 10 days after DTPA application the fecal excretion was higher by 3.5% in comparison to the control group. Subsequently it decreased to the level of the controls. (auth)

19031 EFFECT OF A DISCHARGE OF A HIGH VOLTAGE CONDENSER ON PERMEABILITY OF A CELL MEMBRANE MODEL. Arleevskii, I. P.; Bezuglov, V. K. (Kazan State Univ.). Byull. Eksp. Biol. Med.; 77: No. 5, 50-51(May 1974). (In Russian).

Investigations were carried out on a model of protoplasmic membrane (frog skin). High-voltage discharge of a condenser considerably increased its permeability for ^{24}Na, ^{42}K, and ^{45}Ca ions. The effect depended on the voltage, polarity of the discharge, and the number of electric pulses. (auth)

19032 LUNG CLEARANCE IN MONKEYS AND DOGS. Metivier, H.; Nenot, J. C.; Masse, R.; Nolibe, D.; Lafuma, J. (CEN, Fontenay-aux-Roses, France). Compt. Rend., Ser. D.; 278: No. 5, 671-674(28 Jan 1974). (In French).

A clinical investigation was effected on lung clearance in monkeys and dogs, the elimination of these aerially administered aerosols being investigated: iron oxide; latex particles; colloidal gold. The slow clearance periods determined are discussed. It seems unlikely that the alveolar clearance can be attributed to a single mechanism in advanced animal species. (FR)

19033 CLEARANCE OF INHALED PARTICLES FROM ALVEOLI BY NORMAL INTERSTITIAL DRAINAGE PATHWAYS. Tucker, A. D.; Wyatt, J. H.; Undery, D. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). J. Appl. Physiol.; 35: No. 5, 719-732(Nov 1973).

Methods were modified for animal keeping (rats), inhalation exposure, tissue staining, and photographic reconstruction of the lung to demonstrate lung clearance under near-ideal, physiological conditions. Inert particles were inhaled into healthy lungs at near-normal (ambient environmental) concentrations. Contrasted with discrepant historic observations, our results suggest new perspectives in interpretation. Aggregates of free particles, with some cells, were shown converging by interstitial pathways on the bronchioloalveolar duct junctions for rapid, early clearance, carried from the alveoli by excess lung liquid draining to the peribronchial, perivascular connective tissue sheaths. Centrally, mild edema of the drainage pathways brought debris and cells onto the surface in alveoli bordering the origins of the alveolar ducts; clefts opened for their discharge as sticky masses through the bronchiolar epithelium. Fine particles passed to the lymphatics through the limiting membrane but were filtered out and extruded from submucosal and bifurcation lymphoid foci. A peristaltic pumping mechanism to drive liquid, draining via the Plateau's borders (interalveolar wall junctions), is suggested from physical properties of stable foams. Associations with environmental pollution problems were drawn. (auth)

19034 DISTRIBUTION OF RADIOACTIVE IODINE IN THE ORGANS AND TISSUES OF VARIOUS SPECIES OF RODENTS. Akhmetov, Z.; Khairutdinov, Kh. Sh.; Khasanova, M. T.; Ivleva, L. M. Biol. Nauki; No. 9, 54-58(Sep 1973). (In Russian).

The distribution of radioactive iodine in the organs and tissues of large sand eels, small jerboa, white rats, and rabbits was not uniform. The maximum was in the thyroid, kidneys, lungs, liver, and stomach, and the minimum in the brain and skeletal muscles. (tr-auth)

19035 INHIBITION OF TRANSPORT OF ^{47}Ca AND ^{85}Sr BY LANTHANUM IN CANINE CORTICAL BONE. Paradis, G. R.; Bassingthwaighte, J. B.; Kelly, P. J. (Mayo Clinic and Mayo Foundation, Rochester, MN). J. Appl. Physiol.; 36: No. 2, 221-225(Feb 1974).

Deposition of ^{85}Sr and ^{47}Ca and blood flow (measured by iodoantipyrine washout) were determined in the tibial cortex of adult dogs after injection of graded doses of lanthanum chloride ($LaCl_3$) and potassium cyanide (KCN) into the right tibial nutrient artery. Deposition of ^{85}Sr and ^{47}Ca, expressed in milliliters per gram of cortical bone in 10 min, was decreased after injections of lanthanum, 0.045 ± 0.008 (mean ± SE) compared to 0.097 ± 0.01 in control experiments ($P < 0.005$). Blood flow was unchanged. Injection of KCN did not affect the mean value of uptake of mineral (0.108 ± 0.01 vs. 0.097 ± 0.01) over the whole range of KCN dosage. Blood flow tended to be slightly higher with lower doses of KCN. These data support the concept of a transport system in bone for bone-seeking isotopes such as ^{85}Sr and ^{47}Ca. (auth)

19036 DISTRIBUTION OF ^{14}C-DIPHENYLHYDANTOIN IN PANCREAS ISLET CELL AND OTHER TISSUES OF TOADFISH. Ryo, U. Y.; Shaw, M. J.; Beierwaltes, W. H.; Ice, R. D. (Univ. of Michigan Medical Center, Ann Arbor). Contract AT(11-1)-2031. J. Nucl. Med.; 15: No. 8, 685-687(Aug 1974).

Tissue distribution of ^{14}C-diphenylhydantoin (^{14}C-DPH) in the toadfish, with particular reference to the pancreatic islet cells, was studied in 24 toadfish at intervals of 10 min to 72 hr. At 10 min after intravenous injection of the tracer dose of ^{14}C-DPH, radioactivity concentration was 8% dose/gm in pancreatic islet cells with a pancreatic islet cell-to-liver ratio of 20:1. This concentration and target-to-nontarget ratio is substantially higher than that achieved previously with selenomethionine. The concentration in the brain was 6.2% dose/gm at 10 min. The ratio of relative radioactivity concentration in islet cells to acinar tissue, blood, liver, and skeletal muscles was: 6, 7, 20, and 27, respectively. Thirty minutes to 2 hr after tracer was injected, radioactivity became highest in the brain and second highest in the liver. (auth)

19037 KINETICS OF ^{18}F AND ITS POSSIBLE APPLICATION IN DIAGNOSTICS OF BONE LESIONS. Kleisner, I. (Charles Univ., Prague); Satrapa, T.; Vrana, V.; Cechova, J.; Mudrova, B.; Svoboda, K.; Hruby, J. Cas. Lek. Cesk.; 112: No. 15, 464-466 (13 Apr 1973). (In Czech).

The metabolism of carrier-free ^{18}F was studied with the aim of applying the radioisotope in diagnostics. The preparation containing ^{18}F was administered iv to rats and its distribution was investigated in the lungs, the spleen, skeletal muscles, in the femur, and in teeth. Experiments were also carried out with dogs in which the retention was studied in the head and the spine. The head and the spine were also studied for the retention of ^{18}F in seven patients of various age and sex. The distribution studies showed that for bones, the optimum scintiscanning time using the radioisotope varied between the 3rd and the 6th hour after iv administration. (Nuclear Sci. Abstr. Czech.)

Plants

19038 EFFECT OF GROWTH TEMPERATURE ON CARBON ISOTOPIC RATIOS IN BARLEY, PEAS, AND RAPE. Smith, B. N. (Univ. of Texas, Austin); Chase, J. B.; Herath, H. M. W. Plant Cell Physiol. (Tokyo); 14: No. 1, 177-181(Feb 1973).

Barley, pea and rape were grown in controlled environments at day/night temperatures ranging from 13/4 to 35/27°C. Shoot tissue was analyzed for changes in the natural abundance ratio of $^{13}C/^{12}C$. More ^{13}C was incorporated during growth at low temperatures than at higher temperatures, but the change in isotopic ratio was not linear over the temperature range employed. (auth)

19039 ELONGATION OF SECONDARY HYPHAE AND TRANSLOCATION OF ^{35}S AND ^{3}H FROM HOST TO PARASITE DURING PRIMARY INFECTION OF WHEAT BY ERYSIPHE GRAMINIS F. SP.

TRITICI. Stuckey, R. E. East Lansing, MI; Michigan State Univ. (1973). 130p. University Microfilms Order No. 74-13,982. Thesis (Ph. D.).

Development of secondary hyphae >10u long is evidence of successful infection of wheat by Erysiphe graminis f. sp. tritici. The lengths of secondary hyphae at 20 to 30 hours after inoculation varied with the parasite/host genotype. There were differences in the kinetics of secondary hyphal elongation on plants of compatible and incompatible genotypes. Differences between incompatible genotypes suggest that the single gene differences for incompatibility are operating via different mechanisms rather than via altered specificity of the same mechanism. Rates of ^{35}S transfer from wheat to E. graminis f. sp. tritici differed with the parasite/host genotype, the stage of parasite development, and the environmental conditions. Inoculated primary leaves cut at the base and given $^{35}SO_4$ for five hour periods in the light had more than twice the radioactivity of inoculated primary leaves given $^{35}SO_4$ in the dark. After considering the amount of label translocated to the epidermis as a result of the environmental conditions used, greatest rates of ^{35}S transfer were found to occur at 18 to 20 hours rather than at 26 hours after inoculation. The amount of ^{35}S uptake and translocation to the epidermis was greater in noninoculated plants than in inoculated plants from 6 to 24 hours after inoculation. Reduction of ^{35}S activity in inoculated plants was independent of spore concentration, parasite/host genotype, and species of Erysiphe used for inoculation. Little is known about the form in which label is transferred from wheat to E. graminis f. sp. tritici. The data suggest that transfer of both methionine and sulfate can occur. The fungus was able to incorporate $^{35}SO_4^{2-}$ into a TCA-insoluble form. Inoculated plants given ^{3}H-methionine transferred ^{3}H to the parasite. Five times the number of molecules appear to be transferred when inoculated plants were given ^{3}H-methionine than when given $^{35}SO_4^{2-}$. When inoculated plants were given both ^{3}H-methionine and $^{35}SO_4^{2-}$, the presence of ^{3}H-methionine inhibited ^{35}S transfer to the parasite by about 60%. Whether this inhibition occurred at the plant cell membrane, the fungal membrane, or both is not known. (auth)

Microorganisms

Refer also to abstract 18657.

New Tracer Techniques

Refer also to abstracts 18168, 18249, 18369–18371, 18391–18395, 18712, 18849, 19020, 19021, 19037, and 20542.

19040 (CONF-740708-8) COMPUTER ASSISTED BLOOD BACKGROUND SUBTRACTION (CABBS) HEPATOGRAPHY WITH ^{131}I AND ^{123}I BROMOSULPHTHALEIN (BSP). Britton, K. E.; Suwanik, R.; Tuntawiroon, C.; Premoydin, M.; Reuben, A.; Narasimha, K.; Myers, M.; Wood, T. P.; Brown, N. J. G. (Middlesex Hospital, London (UK). Inst. of Nuclear Medicine; Mahidol Univ., Bangkok (Thailand)). 1973. 24p. (SM-185/66). Dep. NTIS (US Sales Only) $4.25.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

The functions of the liver are reviewed and various tests of liver function for the early detection of disorders related to the uptake of alcohol or drugs, the differentiation between different types of jaundice and cirrhosis, and the diagnosis and localization of neoplasms are discussed. The diagnostic value of scintiscanning following the administration of ^{131}I- or ^{123}I-bromosulphthalein (BSP) for the evaluation of liver function is evaluated. Methods for the chemical preparation of labeled BSP and the use of computer calculations for data processing are described. (CH)

19041 (CONF-740708-21) COMPUTER ANALYSIS OF RADIOCARDIOGRAMS OF PATIENTS WITH INTRACARDIAC SHUNTS. Ivancevic, D.; Price, R.; Rhea, T.; Graham, T.; Atwood, G. F.; Brill, A. B. (Vanderbilt Univ., Nashville, Tenn. (USA). Div. of Nuclear Medicine and Biophysics). 1973. 11p. (SM-185/28). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

In 112 patients catheterized for congenital heart disease, radiocardiographic data were collected by right atrial injection of ^{113m}In. Four scintillation detectors were used to monitor the activity changes in the heart, lungs, and head. The heart measurements were done with both frontal and left lateral detectors, the latter being constructed for better collimation and efficiency. The CAMAC system and PDP-9 computer served for data collection, storage, and display. Data were recorded at 10 or 20 points per second and the pulsatile nature of heart curves appeared. Since radiocardiograms in patients with shunts are complex, a computer program PULSE incorporating a pulsatile heart model was written for radiocardiogram simulation and analysis. The model consists of a series of compartments pulsating alternately. From each compartment a certain fraction of indicator is ejected into the next compartment and added to the indicator retained there. Each cardiac chamber is represented by one compartment, while pulmonary and systemic circulation are represented by a series of paired number of compartments. For shunt simulation a certain fraction can be ejected backward or forward along the series. In order to shorten the computation only the end-diastolic and end-systolic states of the compartments were fit. In left-to-right shunts the heart and lung curves show recirculation peaks with hemodynamically significant shunts. In right-to-left shunts where the heart curve is nonspecific, the head curve detects the early arrival of indicator and shows a biphasic character. The addition of a computer for data acquisition and for pulsatile model simulation and analysis makes it possible to estimate shunt flows. Estimates correlate well with results of standard types of shunts measurements. (auth)

19042 (CONF-740708-22) CHOICE OF LABEL AND MEASUREMENT TECHNIQUE IN TRACER STUDIES OF BODY PROTEIN METABOLISM IN MAN. James, W. P. T.; Sender, P. M.; Garlick, P. J.; Waterlow, J. C. (London School of Hygiene and Tropical Medicine (UK)). 1974. 11p. (SM-185/67). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

Measurement of the turnover rates of proteins in human tissues is difficult because of the problem of obtaining samples. Recent developments are described that use ^{14}C- or ^{15}N-labeled amino acids to measure protein turnover in two ways: either by determining the rate of uptake of label into protein, as a measure of synthesis; or by prelabelling body proteins and following the loss of label as a measure of the rate of breakdown. These two approaches should give the same result if the protein pool is in a steady state. (CH)

19043 (CONF-740708-23) DYNAMIC FLOW STUDIES OF THE ESOPHAGUS AND THE STOMACH USING A RADIOACTIVE DRINK. Kazem, I.; Schmidt, W. J. H.; de Jong, J.; Verdijk-Verbeeten, E. (Katholieke Universiteit Nijmegen (Netherlands)). 1974. 12p. (SM-185/57). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

Technetium-99m-sulfur colloid was used as the tracer for flow studies of the upper gastrointestinal tract, including the investigation of swallow function and the rate of gastric emptying in patients with esophageal and mediastinal carcinomas. Following the oral administration of a radioactive drink, the passage of the activity bolus, from the pharynx to the stomach was visualized and continuously recorded by means of a gamma camera. This offers anatomic and functional information of the esophagus. The rate of gastric emptying was also determined following the administration of the radioactive drink as part of a standard meal with measurements of the gastric activity made serially. (CH)

19044 (CONF-740708-34) ESTIMATION OF SLOW DYNAMIC FUNCTION PARAMETERS IN IRON KINETICS STUDIES USING QUANTITATIVE MEASUREMENTS AND COMPARTMENTAL MODELLING ANALYSIS. Price, R. R.; McKee, L. C. Jr.; Krantz, S. B.; Brill, A. B. (Vanderbilt Univ., Nashville, Tenn. (USA)). Div. of Nuclear Medicine and Biophysics; Veterans Administration Hospital, Nashville, Tenn. (USA)). 1973. 9p. (SM-185/38). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

Whole-body counting techniques were developed for studies of Fe metabolism in patients. They provide quantitative estimates of organ uptake of ^{59}Fe administered in tracer quantities. The imaging system is a heavily shielded whole-body rectilinear scanner coupled to a PDP-9 digital data acquisition system. Digital data obtained from the scanner are analyzed and regional activity determined using transmission and emission measurements. These data are then analyzed using compartmental modelling techniques to obtain least-squares best estimates of net organ content. The unique combination of quantitative measurements and compartmental modelling techniques provides information currently unavailable by any other means. Initial studies carried out in normal subjects led to the establishment of a realistic model and normal (expected) values of the model parameters. The study of iron kinetics was carried out in a number of patients suffering from a variety of erythropoietic

disorders, including leukemia, red cell aplasia, sickle cell and other anemias, and paroxysmal nocturnal hemoglobinuria (PNH). Examples of abnormal findings are reported that display typical variations from normal kinetics. (CH)

19045 (CONF-740708-43) KINETICS OF LACTATE TURNOVER AND OXIDATION IN MAN. Searle, G. L.; Shames, D.; Cavalieri, R. R.; DeGrazia, J.; Zarcone, V.; Poret, D. Jr.; Bagdade, J. D. (Veterans Administration Hospital, Palo Alto, Calif. (USA); Veterans Administration Hospital, Seattle, Wash. (USA); California Univ., San Francisco (USA). Medical Center). 1974. 5p. (SM-185/47). Dep. NTIS (US Sales Only) $4.00.

From symposium on dynamics studies with radioisotopes in clinical medicine and research; Knoxville, Tennessee, USA (15 Jul 1974).

The turnover and oxidation of lactic acid were studied in man employing ^{14}C-lactic acid, ^{14}C-glucose, and ^{14}C-alanine. These various labels employed in separate studies were used to develop a complete scheme for the kinetics of lactic acid in man. (auth)

19046 INTRODUCTION OF RADIOACTIVE 5-FLUOROPYRIMIDINES IN CANDIDA. 5-Fluorocytosine Resistance Mechanisms. Drouhet, E.; Montplaisir, S.; Mercier-Soucy, L. (Institut Pasteur, Paris). Compt. Rend., Ser. D; 278: No. 6, 715-718(4 Feb 1974). (In French).

The incorporation of ^{14}C-labeled pyrimidines and 5-fluoropyrimidines (5-fluorocytosine and 5-fluorouracil) in 5-fluoropyrimidine resistant phenotypes selected from wild strains of human origin Candida revealed the existence of a strong correlation between the minimum inhibiting concentration and the level incorporated. Various permease resistance and functioning mechanisms were determined. (FR)

19047 DATA PROCESSING APPARATUS FOR NUCLEAR MEDICINE. Tsukada, W. (Hitachi Medico, Japan). Ikakikaigaku Zasshi; 44: No. 2, 68-71(Feb 1974). (In Japanese).

Described were the structure, function, and actual clinical cases of the radioisotope image processing apparatus making use of a small computer. The apparatus consists of the input part where data (gamma ray spectra, time-course kinetic measurement, the image of scintiscanner) is subjected to digital processing, the processing part having a small computer equipped with a core memory of 8K words, the indicator part consisting of CFT display indicating analog diagrams, the supplemental memory part, and data typewriter. The position resolving power in digital processing of scintiscanner data and the time resolving power were examined. The image indicating apparatus by graphic display was described. Image processing functions mentioned were digital measurement, deformation of the image, correction of data, new methods of measurement (dynamic function, subtraction), and data processing (fitting of the curve, recognition of pattern). Display procedures of scintigram and clinical cases of subtraction and dynamic study were shown as processed cases. The method of data processing differs according to the conditions for measurement, the target organ, and disease, but information to be obtained is increased by appropriate processing. (JA)

19048 NEW METHOD FOR A MEASUREMENT OF RIGHT VENTRICULAR RESIDUAL RATIO USING ^{131}I-MAA. Kanemoto, N.; Tomoda, H.; Handa, S.; Kunieda, T.; Ogino, T. (Keio Univ., Tokyo). Kokyu To Junkan; 22: No. 3, 215-220(Mar 1974). (In Japanese).

A new method for measurement of right ventricular residual ratio using ^{131}I-macroaggregated albumin (MAA), which was applied by right heart catheterization, is described with special reference to the normal values. Subjects received right heart catherization. The tip of NIH (or USCI) porotic catheter was kept at the apex of the right ventricle. About 50 μCi of ^{131}I-MAA was rapidly infused through this catheter with salt water. As scintillation detector, two detectors for right ventricular and lung field directions were used. Radioisotope dilution curve obtained from the detector of the right ventricular direction was changed by the effect of radioactivity accumulating in the lung field. Therefore, it was revised by using the accumulation curve of the lung field obtained from the detector of the lung field direction. Right ventricular residual ratio was obtained from the real dilution curve $I = Ioe^{-\lambda t}$ of the right ventricle (Io = ^{131}I-MAA infusion amount, λ = exponential content, and I = absolute quantity of ^{131}I-MAA after t seconds). The right ventricular residual blood volume and right ventricular endodiastolic volume were decided as ESV and EDV, respectively. In addition, when ^{131}I-MAA absolute quantity after t_1 and t_2 seconds were decided as Ik and Im, assuming $m - k = n$ and $t_2 - t_1 = t$. EDV was obtained from $ESV/EDV = e^{-\lambda t/n}$. In order to study the normal values of the right ventricular residual ratio, six patients (17 to 31 years in age, one male and five females) with no heart and lung diseases were selected from the out-patients in the Department of Medicine, Keio University Hospital. The right ventricular residual ratio, the right ventricular endosystolic volume and the right ventricular endodiastolic volume were 52.6 to 66.2% (average 57.8%), 39.2 to 72.4 ml/m^2 (average 53.2 ml/m^2) and 72.0 to 109.3 ml/m^2 (average 89.4 ml/m^2), respectively. These values were compared with normal values by other methods, and are shown. (JA)

19049 DIFFERENTIATION AMONG MYCOBACTERIAL SPECIES BY THIN-LAYER CHROMATOGRAPHY OF ETHANOL-SOLUBLE FRACTION AFTER INCUBATION WITH ^{35}S-METHIOINE. Tsukamura, M.; Mizuno, S. (Chubu-Bryoin National Sanatorium, Aichi, Japan). Iryo; 28: No. 2, 143-148(Feb 1974). (In Japanese).

A method is described that uses thin-layer chromatography of the ethanol-soluble fraction after incubation with ^{35}S-methionine for differentiation among mycobacterial species. (JA)

19050 GENERAL PRINCIPLES IN THE USE OF LABELLED MICROSPHERES. Moretti, J. L. (Hospital Henri-Mondor, Creteil, France). Nouv. Presse Med.; 3: No. 20, 1291-1294 (18 May 1974). (In French).

The hypotheses and general principles that govern the use of microspheres in the determination of relative blood flow rates and shunt values are reviewed. The way in which these measurements are made varies in accordance with the site of the organ in the circulation. (FR)

19051 UMBILICO-PORTAL SCINTIGRAPHY: PRELIMINARY RESULTS. Moretti, J. L.; Vasile, N.; Velluet, M.; Gross, G. (Hopital Henri-Mondor, Creteil, France). Nouv. Presse Med.; 3: No. 20, 1295-1298(18 May 1974). (In French).

Using a surgical technique involving exposure of and injection into the umbilical vein, and with reference to work previously carried-out using microspheres, a technique is described which should make it possible to determine the form and contours of hepatic segments at scintigraphy, segmental activity following the point of injection in relation to portal flow, and the study of extra-hepatic shunts. (FR)

19052 RADIOIMMUNOASSAY OF PG Fα. Charbonnel, B.; Soubrier, A.; Dray, F. (Institut Pasteur, France). Ann. Endocrinol. (Paris); 34: No. 6, 722-724(Nov 1973). (In French).

Antibodies with high affinity (K = 6, 1.10^9 L/M) were produced in rabbits immunized with a conjugate of $PGF_2\alpha$ linked to BSA by reaction with carbodiimide reagent. A radioimmunoassay was developed using dextran-coated charcoal to separate the free from the AB-bound $PGF_1\alpha^3H$. The sensitivity of the method is about 7 pg. Cyclohexane-ethyl acetate (I/I) is used for extraction of plasma and lipids and various PG are separated on a small silicic acid column. Recovery of $PGF_2\alpha^3H$ through the extraction and separation procedures is about 80%. The mean plasma PGF level in adult males (n = 18) was found to be 9.3 ± 3.5 pg/ml, in adult females, follicular phase (n = 11) 6.38 ± 2.7 pg/ml and luteal phase (n = 12) 5.7 ± 2.3 pg/ml. Eleven corresponding plasma (8.2 ± 1.5 pg/ml) and serum (31.3 ± 1.5 pg/ml) samples were found to give different results ($p < 0.01$). The mean PGF level in seminal fluid was found to be 5.88 ± 1.7 μg/ml. Extreme care and standardization in collecting blood samples is necessary. (FR)

19053 ESSENTIAL ARTERIAL HYPERTENSIONS. Use of Isotopic Methods for Their Exploration. Application to Low Renin Activity Nonstimulable Arterial Hypertension. Olmer, M. (Hospital de la Conception, Marseille); Salvadore, J. M.; Paulin, R.; Sommer, A.; Marion, J. Nouv. Presse Med.; 3: No. 5, 233-236(2 Feb 1974). (In French).

The usefulness of isotopic methods in the exploration of hypertensions was studied. 47 patients suffering from noncomplicated essential arterial hypertension were investigated. ^{22}Na and ^{42}K were used to measure exchangeable sodium and potassium in the system, labeled human albumin serum was used to study the plasma volume, and tritiated water was used to study the total water contents. Most workers in this field have observed that in about 25% of the cases of essential arterial hypertension, the exchangeable sodium and plasmatic volume levels are high, while the potassium level is reduced, and the renin activity normal or low and nonstimulable. The aldosterone production is normal. An excess mineralocorticoid secretion and sodium retention were the most frequently observed physiopathological mechanisms, these mechanisms probably being a consequence of the exchanges taking place. A 400mg daily spironolactone dose often corrected the rise in blood pressure. (FR)

19054 EVALUATION OF ^{133}Xe TECHNIQUES FOR MEASUREMENT OF REGIONAL VENTILATION. Jones, R. H.; Goodrich, J. K.; Sabistan, D. C. (Duke University, Durham, NC). J. Nucl. Med.; 15: No. 7, 598-604(Jul 1974).

Despite widespread clinical use of radioactive gases for evaluation of regional ventilation, little evidence is available for evaluating the accuracy of these techniques. Excised dog lung prepara-

tions with controlled perfusion and ventilation were used in the present study to compare known ventilation to the rate of alveolar clearance of ^{133}Xe. Xenon-133 was administered by three different methods in separate groups of determinations. Perfusion of the excised lung preparations with blood collected by exsanguination permitted assessment of ventilation by a technique similar to the injection of ^{133}Xe dissolved in saline in patients. The standard error of the distribution of ventilation measured by this approach in 17 determinations was 4.1%. In the second group of experiments, ^{133}Xe in air was administered by a single inhalation and the washout of ^{133}Xe compared with the known distribution of ventilation with a standard error of 5.1%. In a third group of determinations, the lung preparations were ventilated with ^{133}Xe mixed in air until counts reached equilibrium and the rate of ^{133}Xe clearance during subsequent air breathing was determined. The distribution of ventilation measured by this approach demonstrated the greatest accuracy of all techniques examined with a standard error of 2.6%. In addition, the actual minute volume was compared with absolute slope values of ^{133}Xe clearance in this single lung preparation and the correlation coefficient of 0.96 further substantiates the inherent accuracy of ^{133}Xe washout for assessment of regional ventilation. (auth)

19055 ^{99m}Tc-LABELED REPLACEMENT FOR ^{131}I-ROSE BENGAL IN LIVER AND BILIARY TRACT STUDIES. Lin, T. H.; Khentigan, A.; Winchell, H. S. (Medi-Physics, Inc., Emeryville, CA). J. Nucl. Med.; 15: No. 7, 613-615(Jul 1974).

A ^{99m}Tc-labeled replacement for ^{131}I-rose bengal in liver and biliary tract studies was developed. This agent, ^{99m}Tc-labeled Hepato-Biliary Scintigraphin, is rapidly cleared from the plasma by the liver with close to 100% hepatic extraction efficiency, followed by nearly complete excretion of activity in bile. Its utility for studying liver, gallbladder, and biliary tract morphology and function are demonstrated. (auth)

19056 REGIONAL LUNG VOLUME MEASUREMENT BY TRANSMISSION SCINTIGRAPHY. Fleming, J. S.; Goddard, B. A. (Southampton University Hospitals, Eng.). J. Nucl. Med.; 15: No. 7, 605-609(Jul 1974).

A technique for the absolute measurement of regional lung volume using transmission scintigraphy is described. A gamma camera placed behind the patient detects radiation passing through the chest from a uniform source containing ^{99m}Tc placed in front. The regional distribution of counts transmitted through the chest is recorded on a data handling unit linked to the camera. The regional distribution of anteroposterior chest thickness is also measured. From these two distributions it is possible, using a digital computer, to calculate the regional variation of lung volume. Total lung volumes measured in this way correlate very well with spirometer measurements. This technique overcomes the errors of regional lung volume measurement using ^{133}Xe gas where chest thickness variation, blood background, and nonuniform labeling of gas in poorly ventilating areas give false values. The technique is useful for measuring distributions of lung volume at different levels of respiration. (auth)

19057 RADIONUCLIDE DIAGNOSIS OF PULMONARY SEQUESTRATION. Prosin, M. A.; Mishkin, F. S. (Martin Luther King Jr. General Hospital, Los Angeles). J. Nucl. Med.; 15: No. 7, 636-638(Jul 1974).

Radionuclide studies demonstrated the lack of bronchial communication and the systemic arterial supply in a case of pulmonary sequestration. The examinations described are simple and innocuous. Such studies might serve for screening to determine vascular supply of pulmonary lesions as an aid in selection of a preferred route for angiography. (auth)

19058 DIMINISHED CEREBRAL PERFUSION RESULTING FROM KINKING OF THE INTERNAL CARTOID ARTERY. Trackler, R. T.; Mikulicich, A. G. (Sharp Memorial Hospital, San Diego, CA). J. Nucl. Med.; 15: No. 7, 634-635(Jul 1974).

Kinking of the internal carotid artery resulted in diminished cerebral perfusion of ^{99m}Tc-pertechnetate given as an intravenous bolus to a patient with recurrent hemiparesis. The subsequent static images were normal. (auth)

19059 SCAN DEMONSTRATION OF DELAYED SPLENIC RUPTURE. Slavin, J. D. Jr.; Mineham, T. F.; Spencer, R. P. (Yale Univ., New Haven). J. Nucl. Med.; 15: No. 7, 632-633 (Jul 1974).

An initial spleen scan performed on a boy following trauma revealed only decreased activity at the lower pole. A second study, 2 days later, showed separation of functional splenic tissue. Splenic rupture was confirmed at surgery. The use of repeat spleen scans in following suspected splenic injury (delayed rupture) was pointed out. (auth)

19060 DIFFERENTIAL VITAL CAPACITY DETERMINATIONS WITH RADIOACTIVE XENON. Serino, T. V. (Tufts Univ. School of Medicine, Boston); MacDonnell, K. F.; Ishikawa, S.; Braverman, L. E.; Abreau, C.; Johnston, R.; Cloonan, E. J. Nucl. Med.; 15: No. 7, 625-629(Jul 1974).

Differential vital capacities (right lung versus left lung) can be obtained with bronchospirometry. Radiospirometry, however, has been shown to be more reproducible and due to its noninvasive nature more acceptable by the examinee. Right lung vital capacities determined by radiospirometry were found to be statistically larger (52%) than the left lung vital capacity (48%) in 28 normal subjects (nonsmokers). The differential data of 11 smokers were not consistent with the above relationship. Vital capacities determined using radioactive xenon showed statistically significantly lower values from those determined by standard spirometry. The noninvasive nature of this technique in determining differential data (regional as well as unilateral) may allow one to locate abnormalities when standard spirometry indicates normal or abnormal pulmonary function. (auth)

19061 FALSE-POSITIVE ^{75}Se-SELENITE SCAN IN NONMALIGNANT LESIONS. De Roo, M. J. K. (Academisch Ziekenhuis St. Rafael Kapucijnenvoer, Leuven, Belgium). J. Nucl. Med.; 15: No. 7, 622-624(Jul 1974).

Several reports describe ^{75}Se-selenite as an excellent tumor tracer. However, the study of the tracer accumulation of ^{75}Se-selenite in animals with nonmalignant lesions (necrotic lesion and infectious abscess in the muscle) shows even higher concentration ratios in comparison with induced mammary tumors. Moreover, ^{75}Se-selenite brain scintigraphy gives no reliable information for differential diagnosis of benign or malignant cerebral pathology. Frequently cerebral infarcts are visualized on brain scan using the aforementioned tracer substances. From experimental and clinical data it appears that ^{75}Se-selenite has only limited value as tumor-specific tracer. (auth)

19062 CLINICAL LIMITATION OF BRAIN SCANNING IN METASTATIC DISEASE. Brooks, W. H.; Mortara, R. H.; Preston, D. (Univ. of Kentucky, Lexington). J. Nucl. Med.; 15: No. 7, 620-621(Jul 1974).

Brain scans of forty-seven patients who underwent craniotomy for metastatic brain tumors from 1965 to 1972 were studied. Scans were performed with ^{99m}Tc-pertechnetate. Seventy-six percent of the patients had positive brain scans with the best correlation existing in metastatic lesions from the lung and malignant melanoma. Brain scans of patients with metastatic adenocarcinoma of the colon were "negative, in spite of a surgically significant space-occupying lesion". The solitary lesions averaged 4-cm in diameter and were grossly totally removed. It can be concluded that a negative brain scan in a patient with cancer and symptoms suggesting neurological disease cannot definitely rule out cerebral metastases. This conclusion is particularly true in patients with colonic cancer. (auth)

19063 IRON HYDROXIDE RETENTION IN PRIMATE LUNGS. Watts, R. S.; Sopher, R. L.; Pena, H. G. (Univ. of New Mexico, Albuquerque). J. Nucl. Med.; 15: No. 7, 616-619(Jul 1974).

The retention and possible toxicity of iron hydroxide particles used for lung scanning were investigated by incorporating ^{59}Fe and injecting the left pulmonary arteries of three monkeys retaining the right lungs for control. Washout rates from external counts were obtained using a special collimator device and the animals were sacrificed at 4 to 7 months. The lungs were assayed for residual radioiron and examined microscopically for iron staining and tissue damage. A three-exponential washout curve with approximate $T_{1/2}$'s of 8 hr, 6 days, and 100 days was obtained. These compartments contained 42 to 54%, 21 to 39%, and 15 to 38%, respectively, of the injected dose. Projection of the slow rate suggests 1 to 4% would remain in the lung after a year. Microscopic examination showed particles up to 8 microns confined to macrophages, with no evidence of tissue damage. It is unlikely that iron hydroxide lung scans pose any risk of long-term toxicity. (auth)

19064 RADIONUCLIDE EVALUATION OF REGIONAL LUNG FUNCTION IN CHILDREN. Treves, S.; Ahnberg, D. S.; Laguarda, R.; Strieder, D. J. (Harvard Medical School, Boston). J. Nucl. Med.; 15: No. 7, 582-587(Jul 1974).

A method suitable for the study of regional lung function in children is described. The method is simple to perform, takes only 2 min, and provides pictorial and numerical information on regional ventilation and perfusion and a scaling factor measured after rebreathing to account for regional variation in lung size and shielding. Although the availability of a computer system such as the one described in the text is essential for precise and rapid numerical evaluation, nuclear medicine laboratories that lack this facility but have a gamma camera could use this method to obtain scintigraphic information alone. (auth)

19065 GALLIUM SCANNING IN ACUTE HEPATIC AMEBIC ABSCESS. Geslien, G. E.; Thrall, J. H.; Johnson, M. C. (Walter

Reed General Hospital, Washington, DC). J. Nucl. Med.; 15: No. 7, 561-563(Jul 1974).

In two cases of acute hepatic amebic abscess ^{67}Ga-citrate was seen to accumulate in the periphery of the abscess cavity. The area of gallium localization appears to be in the region of hyperemia seen histologically and arteriographically. Liver scanning with ^{67}Ga-citrate may be more accurate than radiocolloid liver scanning for assessing the size and resolution of acute hepatic amebic abscess. (auth)

19066 SYNTHESIS OF HIGHLY RADIOACTIVE NITROGEN MUSTARDS AND THEIR IN VIVO ALKYLATION OF DNA IN MOUSE TUMOR CELLS. Taylor, B. Jr. Philadelphia; Univ. of Pennsylvania (1973). 109p. University Microfilms Order No. 74-14,146.

Thesis (Ph. D.).

Very radioactive nitrogen mustards have been synthesized and their purity determined. Compounds of Bis (β-chloroethyl) methylamine · HCl (HN2) and N,N-diethyl (2-chloroethyl) amine · HCl (HN1A) were synthesized from their tritium labelled precursors. The purity and specific activities of these compounds were determined using paper chromatography and the 4-(p-nitrobenzyl)-pyridine color reaction. Using these methods nitrogen mustards of greater than 90% purity and specific activities of 5 Ci/mM were obtained. These very radioactive alkylating agents (HN1A and HN2) were used for in vivo administration of low doses (0.6 to 0.2 mg/kg) to Swiss mice containing 7 day Ehrlich ascites tumors. Studies were made of the isolated DNA obtained from these tumors and comparisons of the alkylation reactions were made. The reaction with HN1A was found to be essentially the same as with HN2; however, the alkylation with HN1A did produce much more of a species which as of yet has not been definitely identified. This species is thought to be a derivative of N-7 alkylated guanine which is produced by rupture of the imidazole ring during acid hydrolysis of the isolated DNA sample. (Diss. Abstr. Int., B)

19067 BRAIN SCANS IN INFANTILE CEREBRAL PARALYSIS. Barrett, L. R.; Mishkin, F. S. (Martin Luther King, Jr. General Hospital, Los Angeles). Radiology; 112: No. 2, 389-392(Aug 1974).

Prominent diploic vascular channels were found on the atrophic side in four adult patients with juvenile hemiatrophy and hemiplegia in addition to the already well-described roentgen findings. Radionuclide angiography demonstrated decreased activity in the affected hemisphere during both the arterial and venous phases. Characteristic features of the delayed radionuclide images included a small hemisphere, seen best on the vertex view, with increased activity most apparent peripherally. Scanning with ^{113m}In-transferrin revealed a decreased blood pool in the small hemisphere. (auth.)

19068 QUANTITATION OF CEREBROSPINAL FLUID SHUNT FLOW. Harbert, J.; Haddad, D.; McCullough, D. (Georgetown Univ., Washington, DC). Radiology; 112: No. 2, 379-387(Aug 1974).

A new method for quantitatively measuring flow through CSF diversionary shunts is described. Shunt reservoirs were injected with 0.05 ml $^{99m}TcO_4^-$ and the clearance, λ, determined. The distribution volume of every known shunt reservoir was ascertained experimentally. CSF flow, F, was determined using the relationship $F = \lambda V$. Good correlation between CSF flow and clinical outcome was found in 14 of 15 patients in whom shunt function was in question. (auth)

19069 ^{99m}Tc-POLYPHOSPHATE UPTAKE WITHIN PULMONARY AND SOFT-TISSUE METASTASES FROM OSTEOSARCOMA. Flowers, W. M. Jr. (Mississippi Univ., Jackson). Radiology; 112: No. 2, 377-378(Aug 1974).

In a patient with primary osteosarcoma of the femur, radionuclide scans demonstrated ^{99m}Tc-polyphosphate uptake within metastatic deposits in the lungs and in the soft tissues of the surgical stump. This agent is useful for the demonstration of extraosseous metastatic osteosarcoma. (auth)

19070 DETECTION OF EXTRAOSSEOUS METASTASES FROM OSTEOSARCOMA WITH ^{99m}Tc-POLYPHOSPHATE BONE SCANNING. Ghaed, N.; Thrall, J. H.; Pinsky, S. M.; Johnson, M. C. (Walter Reed Army Medical Center, Washington, DC). Radiology; 112: No. 2, 373-375(Aug 1974).

Two cases of osteosarcoma of the femur are presented. In both patients, bone scans confirmed the presence of pulmonary metastases. ^{99m}Tc-polyphosphate (TcPP) localizes in the extraskeletal pulmonary metastases, including some not demonstrated radiographically. Thus the TcPP scan is a valuable adjunct in the staging and therapeutic planning of patients with primary malignant bone tumors. (auth)

19071 REVIEW OF SOLITARY ^{18}F BONE SCAN LESIONS. Shirazi, P. H.; Rayudu, G. V. S.; Fordham, E. W. (Rush-Presbyterian-St. Luke's Medical Center, Chicago). Radiology; 112: No. 2, 369-372(Aug 1974).

From 58th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (26 Nov 1972).

Eight per cent of all ^{18}F bone scans and 11% of abnormal scans demonstrate solitary lesions. This review analyzes 100 solitary lesions and the correlation with radiologic, pathologic, and clinical findings. Several interesting findings and patterns emerge. Metastatic tumor accounts for 54% of the solitary lesions of which less than half are apparent roentgenographically, requiring pathologic examination for confirmation of final diagnosis. Roughly one fourth of solitary lesions occur in the extremities. At least half were totally unsuspected clinically which shows the importance of scanning the entire skeleton. Etiology and location of the lesions are discussed. (auth)

19072 ^{18}F BONE SCANNING: REVIEW OF INDICATIONS AND RESULTS OF 1,500 SCANS. Shirazi, P. H.; Rayudu, G. V. S.; Fordham, E. W. (Rush-Presbyterian-St. Luke's Medical Center, Chicago). Radiology; 112: No. 2, 361-368(Aug 1974).

From 58th scientific assembly and annual meeting of the Radiological Society of North America; Chicago, IL (26 Nov 1972).

Indications for and results of ^{18}F bone scanning are reviewed. Of 1,500 scans, 980 abnormal scans demonstrated 963 skeletal and 92 nonskeletal abnormalities. Forty-six per cent of 1,265 scans obtained for malignant disease were positive for metastasis, with a high incidence in primary lesions not considered bone-metastasizing. Incidence of unsuspected polyostotic disease in primary bone tumor is reported. Serial bone scanning is useful in evaluating response to therapy. In 50% of patients with isolated pain or elevated alkaline phosphatase levels the skeleton was the responsible agent. Because extremity involvement is common, scanning of the entire skeleton is stressed. (auth)

19073 SCINTILLATION SCANNING OF THE BRAIN. Brownell, G. L.; Correia, J. A.; Hoop, B. Jr. (Massachusetts General Hospital, Boston). pp 365-386 of Annual Review of Biophysics and Bioengineering. Vol. 3. Mullins, L. J. (Ed.). Palo Alto, CA; Annual Reviews, Inc. (1974).

Studies on scintillation scanning of the brain are reviewed. Radionuclide localization is discussed with regard to the blood-brain barrier and radiopharmaceuticals. Instrumentation for brain scanning is reviewed with regard to rectilinear scanning; positron scanning; gamma camera devices; improvements and design variations of the Anger camera; image-intensifier camera; Fresnel zone-plate imaging; spark chambers; multiwire proportional counters; and solid-state devices. Radionuclide tracer techniques for studies on dynamic function of the brain are also discussed. (HLW)

19074 INCREASED SPECIFICITY OF LIVER SCANNING WITH THE USE OF ^{67}Ga CITRATE. Lomas, F.; Dibos, P. E.; Wagner, H. N. Jr. (Johns Hopkins Medical Institutions, Baltimore). New Engl. J. Med.; 286: 1323-1329(1972).

Sixty-one patients with focal defects on colloid liver scan and two with infrahepatic mass lesions were studied with ^{67}Ga citrate. Definite accumulation of the radionuclide was noted in the lesions of 23 of 30 patients with hepatic cancer—11 of 12 with hepatocellular carcinoma, four of nine with metastatic adenocarcinoma, two with squamous-cell carcinoma, two with malignant melanoma, two with Hodgkin's disease, one with undifferentiated carcinoma and one with hepatoblastoma. The tracer was poorly taken up by five metastatic adenocarcinomas and one malignant carcinoid. Four of six patients with liver abscess and one with cirrhosis also had appreciable accumulation of gallium in the liver lesions. Twenty-six other patients with benign conditions producing focal defects on the colloid liver scan did not have appreciable uptake of gallium. The gallium studies were helpful in the detection of hepatoma in patients with cirrhosis and in differentiating cancer and abscess from more benign causes of an abnormal liver scan. (auth)

19075 INCORPORATION OF ^{125}I-LABELED 5-IODO-2′-DEOXYURIDINE INTO THE DNA OF MOUSE MAMMARY TUMORS. Dethlefsen, L. A. (Univ. of Pennsylvania, Philadelphia). pp 186-201 of Normal and Malignant Cell Growth. Fry, R. J. M. (Ed.). New York; Springer-Verlag (1969).

An evaluation is presented of ^{125}I-IUdR as a tracer for DNA metabolism in the C3H mouse mammary tumor, with special emphasis on the feasibility of using in situ, externally counted, tumor radioactivity as an index of DNA accumulation in the intact tumor. (ERB)

19076 ATLAS OF GALLIUM-67 SCINTIGRAPHY. A New Method of Radionuclide Medical Diagnosis. Johnston, G. S.; Jones, A. E. New York; Plenum Publishing Corporation (1973). 229p. $25.00.

The usefulness of ^{67}Ga citrate as a scanning agent for the detection and localization of neoplasms is reviewed. Results obtained in the localization of neoplasms in bone tissues, reticuloendothelial system, hematopoietic system, gastrointestinal tract,

pelvis, mammary glands, and brain are reported. Uptake of ^{67}Ga by malignant melanomas and in inflammations is discussed. (CH)

19077 WHY DO A LUNG SCAN? Shoop, J. D. (Univ. of New Mexico, Albuquerque). J. Amer. Med. Ass.; 229: No. 5, 567-570 (29 Jul 1974).

Radioisotope scans of the lungs for estimates of the relative degree of ventilatory or perfusion abnormality in chronic lung disease can be of value in assessing response to therapy, advisability of surgical therapy, or quantification of disability, as in patients with pulmonary tuberculosis. Staging of carcinoma of the lung has occasionally been aided by perfusion imaging since total occlusion of a pulmonary artery is easily identified on scan. However, the finding of unilateral absence of perfusion has been reported with incomplete pulmonary artery obstruction by the malignant neoplasm as well. The method is often valuable for the differential diagnosis of pulmonary embolus and pulmonary infarction. Evaluation of restrictive lung abnormalities, subdiaphragmatic abscess, pericardial disease, α-antitrypsin deficiency, and other entities has, at times, included the use of both ventilation and perfusion imaging. Radionuclide imaging of the perfusion and ventilation distribution in the lungs, when performed in a timely fashion after onset of clinical symptoms, often provides clear-cut evidence of pulmonary embolic disease. In situations where the radionuclide images are equivocal, because of secondary perfusion changes, the use of pulmonary arteriography may be considered as a more definitive maneuver. Information about the extent of nonembolic pulmonary disorders can also be obtained from perfusion and ventilation images, information that may be useful in patient treatment or in interpretation of pulmonary function studies. (CH)

19078 MEASUREMENT OF RELATIVE BLOOD FLOW TO EACH ORBIT BY DYNAMIC ISOTOPE SCANNING USING PERTECHNETATE-99m. Schachar, R. A.; Weiter, J. J.; Ernest, J. T.; Stark, V.; Hoffer, P. B. (Univ. of Chicago). Amer. J. Ophthalmol.; 77: 223-226 (Feb 1974).

A method of orbital scanning and counting measures relative blood flow to the eyes by recording the radioactivity appearing immediately after antecubital intravenous injection of pertechnetate-99m. The technique requires the use of a pinhole collimator and a magnetic tape playback with a region-of-interest counter in order to obtain measurement of total counts for each second of the analysis time specifically from the eyes. The method is sufficiently sensitive to detect a decrease in blood flow to the eyes after carotid compression and exenteration, and an increase in blood flow after sympathectomy. (auth)

19079 PENTAZOCINE RADIOIMMUNOASSAY. Williams, T. A.; Pittman, K. A. (Sterling-Winthrop Research Inst., Rensselaer, NY). Res. Commun. Chem. Pathol. Pharmacol.; 7: No. 1, 119-143 (Jan 1974).

Antibodies were produced from rabbits immunized with two pentazocine antigens, one containing a carboxymethyl derivative of pentazocine (CMP) and the other containing an azobenzoic acid derivative of pentazocine (ABAP). Corresponding radioimmunoassays were developed for these two antibodies, utilizing ^{3}H-pentazocine and ammonium sulfate precipitation. The specificities of the antibodies to various benzazocines and other related compounds were determined by finding the concentration of compound needed to inhibit 50% of the ^{3}H-pentazocine binding to the antibody. None of the known metabolites of pentazocine cross-reacts to any appreciable extent with the ABAP-antiserum, whereas a conjugate of pentazocine does cross-react with the CMP-antiserum. Other benzazocines tested showed similar, low affinities for both antibodies. Methods for the analysis of pentazocine in plasma and urine were developed. The presence of plasma or urine interfered with the radioimmunoassay, but benzene extracts of plasma and urine did not. (auth)

19080 GASTRIC EMPTYING RATE AS MEASURED BY A RADIOISOTOPIC TECHNIQUE. Gomez-Perez, F. J.; Ryan, J. R.; Staub, R.; Vargas, J. R. J. Med. Ass. State Ala.; 43: No. 8, 493-495 (Feb 1974).

Modification of a non-invasive technique for measuring the rate of gastric emptying is described. Radiolabelled sodium chromate (200 yCi) in a glucose solution was employed. The rate of isotope disappearance from the stomach, assessed by external counting was used to study the rate of gastric emptying. The method is simple, safe, and provides information in a single test. (auth)

19081 TUMOR SCANNING AGENTS. Hoffer, P. B.; Gottschalk, A. (Franklin McLean Memorial Research Inst., Chicago). Semin. Nucl. Med.; 4: No. 3, 305-316 (Jul 1974).

Nuclear imaging studies currently play a major role in the detection, staging, and management of malignant disease. However, most imaging methods with agents currently in use localize malignant disease indirectly by revealing changes in normal anatomy or physiology. These methods are inherently nonspecific. The development of direct tumor scanning agents, which localize in the tumor itself, holds considerable promise. Substances currently in use include radiolabeled metabolites, radioactive cations, and radiolabeled antimetabolites. At least some of these agents show good specificity. Radiolabeled antibodies to tumor-associated antigens are currently undergoing initial investigation as direct scanning agents with high tumor specificity. (auth)

19082 CLINICAL USE OF A SOLID-PHASE RADIOIMMUNOASSAY SPECIFIC FOR HUMAN CHORIONIC GONADOTROPIN. Kosasa, T. S.; Levesque, L. A.; Goldstein, D. P.; Taymor, M. L. (Peter Bent Brigham Hospital, Boston). Amer. J. Obstet. Gynecol.; 119: No. 6, 784-791 (15 Jul 1974).

A rapid radioimmunoassay specific for human chorionic gonadotropin (hCG) has been developed. Elimination of cross-reactivity with luteinizing hormone (hLH) was obtained by utilizing an antiserum with a specificity for the beta subunit of hCG. A solid-phase system, in which the antibody was bound to CNBR-activated sepharose in a preliminary step, reduced the minimum incubation time of the assay to two hours. The assay has been found to be of particular value in those conditions where in the concentration of hCG as measured by previously described assays would be affected by circulating levels of hLH: i.e., early implantation, unruptured ectopic pregnancy, threatened abortion, and trophoblastic disease under chemotherapy. (auth)

19083 MYOCARDIAL IMAGING USING ^{43}K AND THE GAMMA CAMERA. Martin, N. D.; Zaret, B. L.; Strauss, H. W.; Wells, H. P. Jr.; Albers, J. (Air Force Medical Center, Travis AFB, CA). Radiology; 112: No. 2, 446-448 (Aug 1974).

Although myocardial imaging with ^{43}K and the rectilinear scanner has been shown to evaluate regional myocardial perfusion reliably, attempts to duplicate these results using a gamma camera have not been satisfactory primarily due to collimator penetration by higher energy gamma rays. Satisfactory images were obtained when the pinhole collimator was fitted with a small insert and additional lead shielding was placed between the collimator and the patient. (auth)

19084 RADIOIMMUNOASSAY FOR DEXAMETHASONE IN PLASMA. Hichens, M.; Hogans, A. F. (Merck Inst. for Therapeutic Research, West Point, PA). Clin. Chem.; 20: No. 2, 266-271 (1974).

A radioimmunoassay for detection of dexamethasone in plasma is described. Antibodies to dexamethasone hemisuccinate coupled to bovine serum albumin were obtained in rabbits and used for binding of the synthetic steroid. Concentrations of dexamethasone between 0.5 and 40 μg/liter of plasma can be measured with this procedure. (auth)

19085 NUCLEAR IN VITRO PROCEDURES. I. Competitive Protein-Binding Radioassays. II. Functional Radioassays and Other Techniques. Murphy, B. E. P. (McGill Univ., Montreal); Wagner, H. N. Jr. Hosp. Pract.; 7: No. 12, 65-72 (Dec 1972).

Biologic substances occurring in such minute quantities that they eluded previous methods can now be assayed in vitro by a variety of nuclear techniques. The quantitative and biologic assays made possible by the use of proteins to capture the target substances, or ligands are described. The uses of ^{131}I, ^{35}S, ^{14}C, and tritium in the evaluation of metabolic events and anomalies in vitro rather than in vivo, and other methods, employing radioactivity measurements, that appear to offer significant potential for clinical application are discussed. (auth)

19086 PRECIPITATION OF CALCIUM AND STRONTIUM SULFATES AROUND PLANT ROOTS AND THEIR SIGNIFICANCE IN ION UPTAKE. Malzer, G. L. Lafayette, IN; Purdue University (1973). 84p. University Microfilms Order No. 74-15,202.

Thesis (Ph. D.).

The mechanisms of Ca^{2+}, Sr^{2+}, and SO_4^{2-} movement to corn (Zea mays L.) roots were investigated to determine the extent of ionic accumulations at the root surface. Additional objectives of this research were to determine if accumulations of these ions would result in precipitation of $CaSO_4$ or $SrSO_4$ at the root surface and to evaluate the influence of the $CaSO_4$ or $SrSO_4$ precipitate on Ca and Sr availability to the plant. Autoradiographic techniques using ^{45}Ca and ^{35}S showed that both Ca^{2+} and SO_4^{2-} accumulated at corn and sorghum root surfaces when their supply to the root by mass flow exceeded uptake. Petrographic studies of corn roots growing in saturated $CaSO_4$ or $SrSO_4$ nutrient solutions showed that precipitates of these salts occurred on the root surfaces. The effect of the $CaSO_4$ and $SrSO_4$ precipitates on the relative uptake of Ca and Sr by corn plants was studied separately utilizing nutrient solution cultures. ^{45}Ca and ^{85}Sr were added to the solutions in two manners, seven hours before the plant was harvested and from the beginning of the experiment (ninth day). Plants were harvested at 13, 17, and

24 days; separated into shoots and roots; and the Sr/Ca uptake ratios compared to plants where no root precipitate was present. The $CaSO_4$ root precipitate resulted in a 20–25% reduction in the amount of Ca relative to Sr translocated to the tops over a 7 hour uptake period. No significant affect in the Sr/Ca ratio was observed when uptake was measured from the beginning of the experiment. When no $CaSO_4$ precipitate was present the Sr and Ca taken up by the plant was in proportion to the concentrations in the external solution. The roots, however, selectively held more Sr in proportion to Ca while the tops had a greater proportion of Ca. The $SrSO_4$ precipitate resulted in a 10–20% reduction in the relative Sr translocation to the top when the solution was labelled from the beginning of the experiment. This was not observed in a seven hour uptake period. When no $SrSO_4$ root precipitate was present, the plant discriminated against Sr, possibly due to the high Sr concentration and low Ca levels. Both the tops and the roots contained more Ca in proportion to Sr but the roots retained a larger proportion of Ca, resulting in a reversal of the top and root ratios observed where Ca was the dominant ion. The $CaSO_4$ and $SrSO_4$ root precipitates did not effect the availability of Ca and Sr in the same manner. A noted influence of the precipitate was, however, present in both experiments indicating its potential influence on nutrient availability. (Diss. Abstr. Int., B)

19087 USE OF THE DELAYED BRAIN SCAN IN DIFFERENTIATING CALVARIAL FROM CEREBRAL LESIONS. Bernstein, J.; Hoffer, P. B. (Univ. of Chicago). J. Nucl. Med.; 15: No. 8, 681-684(Aug 1974).

A series of 92 sequential positive ^{99m}Tc-pertechnetate brain scans on 69 patients was reviewed. Each patient was scanned early following injection of radionuclide and again approximately 3 hr after injection. The change in relative radioactivity in the lesion compared with the rim radioactivity was useful in revealing whether the lesion was intracerebral or calvarial. In more than 80% of the calvarial lesions, the radioactivity tended to decrease between early and delayed views whereas more than 90% of the intracranial lesions tended to increase in relative radioactivity on the delayed view. Exceptions to this general pattern were noted in both categories of lesions. The combination of early and delayed scans gives information regarding the location of brain lesions which is not obtained from either study alone. The technique represents an additional parameter to be considered in the determination of the location of a lesion on brain scan even though it does not achieve complete specificity. (auth)

19088 APPEARANCE OF PERIPHERAL POSTSURGICAL ACTIVITY ON CEREBRAL DYNAMIC STUDIES. Witherspoon, L. R.; Tyson, J. W.; Goodrich, J. K. (Duke Univ. Medical Center, Durham, NC). J. Nucl. Med.; 15: No. 8, 709-711(Aug 1974).

Peripheral ^{99m}Tc-pertechnetate tracer activity seen on cerebral dynamic studies obtained following brain surgery was evaluated. Abnormal peripheral activity was seen in the surgical site in the venous phase of studies performed within 6 months of surgery. Persistence of abnormal activity beyond 6 months on repeated examinations was not observed in this series. Identification of abnormal peripheral activity more than 6 months postoperatively suggests skull or scalp infection or peripheral intracranial abnormality. (auth)

19089 EPIDURAL HEMATOMA WITH DECREASED RADIONUCLIDE UPTAKE. Silberstein, E. B. (Univ. of Cincinnati Medical Center). J. Nucl. Med.; 15: No. 8, 712-713(Aug 1974).

A unique ^{99m}Tc-pertechnetate scintigraphic finding in a case of epidural hematoma was an area of decreased pertechnetate uptake in the area of the angiographically documented lesion. The avascularity of the acute lesion and pressure effects on surrounding vessels may account for this appearance. (auth)

19090 ANALYSIS OF THE RELATIONSHIP BETWEEN ^{99m}Tc–Sn–POLYPHOSPHATE AND ^{99m}Tc–Sn–PYROPHOSPHATE. Bowen, B. M.; Garnett, E. S. (McMaster Univ., Medical Center, Hamilton, Ont.). J. Nucl. Med.; 15: No. 8, 652-655(Aug 1974).

Studies of the hydrolysis of ^{99m}Tc–Sn–polyphosphate and ^{99m}Tc–Sn–pyrophosphate were made. Results show that ^{99m}Tc–Sn–polyphosphates are readily hydrolyzed both in vitro and in vivo. It is suggested that ^{99m}Tc–Sn–pyrophosphate is the stable unit which localizes in the bone and is used for scintiscanning. (CH)

19091 USE OF INDIUM CHLORIDE SCINTIGRAPHY IN PATIENTS WITH MYELOFIBROSIS. McNeil, B. J.; Holman, B. L.; Button, L. N.; Rosenthal, D. S. (Harvard Medical School, Boston). J. Nucl. Med.; 15: No. 8, 647-651(Aug 1974).

Various diagnostic modalities have been used to assess the degree and anatomic extent of erythroid elements in the marrow. Scintigrams of ^{111}In-chloride uptake have been suggested for this purpose, but data regarding the association of ^{111}In-chloride activity with erythroid elements are lacking. The distribution of ^{111}In-chloride was compared with results from bone marrow biopsies, ferrokinetic data, liver and spleen histology, and the clinical status in 21 patients (18 with myelofibrosis and 3 with other hematological disorders). In 15 patients the sacral uptake of ^{111}In-chloride correlated with marrow biopsy, ferrokinetic data, and clinical status. In five patients the scintigrams overestimated erythroid elements when compared with biopsy results but were consistent with ferrokinetic data and clinical status, suggesting that there is a limitation imposed on marrow biopsies because of sampling. Activity in the liver and spleen did not correlate with the presence of erythropoietic elements assessed histologically. Indium-III-chloride scintigraphy appears to be a reliable means of assessing erythroid elements in bone marrow but not in the liver and spleen. (auth)

19092 ^{59}Fe WHOLE-BODY SCANNING. Chaudhuri, T. K.; Ehrhardt, J. C.; DeGowin, R. L.; Christie, J. H. (Univ. of Iowa, Iows City). J. Nucl. Med.; 15: No. 8, 667-673(Aug 1974).

A collimator was built, which allows whole-body scanning with 10 μCi of ^{59}Fe using a dual-probe Ohio-Nuclear 8-in. scanner. Statistical fluctuations on the scan are minimized with a large Gaussian spot light shaper. The system is useful for visualizing marrow distribution, assessing hemopoietic function, determining sites of red-cell sequestration, and evaluating hepatic storage iron deposition. Concomitant clinical, morphologic, and ferrokinetic studies confirmed the findings obtained from ^{59}Fe whole-body scanning. This technique distinguishes between focal and generalized hemopoietic insufficiency. Thus, focal ablation of erythropoiesis in the bone marrow following radiation therapy can be easily demonstrated with ^{59}Fe whole-body scanning. Preliminary studies suggest that doses of irradiation commonly used in the initial treatment of malignant lymphoma may prevent repopulation of bone marrow in radiated areas for at least 8 to 12 months. (auth)

19093 USE OF ^{99m}Tc AS A RADIOISOTOPIC LABEL TO STUDY THE MIGRATORY PATTERNS OF NORMAL AND NEOPLASTIC CELLS. Barth, R. F.; Singla, O.; Gillspie, G. Y. (Univ. of Kansas Medical Center, Kansas City). J. Nucl. Med.; 15: No. 8, 656-661(Aug 1974).

Technetium-99m was used as a radioisotopic label to study the migratory patterns of syngeneic and xenogeneic lymphocytes and erythrocytes in mice. Maximum splenic and hepatic localization of lymphocytes and erythrocytes was attained 1 to 2 hr following intravenous injection. The mean liver/spleen ratio was 6.2 with syngeneic murine thymocytes and 14.0 with human peripheral blood lymphocytes. When syngeneic murine erythrocytes were administered intravenously approximately equal numbers of cells localized in the liver and spleen. In contrast, when xenogeneic sheep RBC were given, there was markedly increased hepatic localization as reflected by a mean liver/spleen ratio of 99.6. There was a linear relationship between the number of lymphocytes or erythrocytes injected and γ counts recorded in the liver and spleen. Technetium-99m was also used as a label to study the distribution of Sarcoma I cells in syngeneic A/J mice. The greatest number of tumor cells localized in the liver and lungs in a ratio approximating unity and this was maximal at 4 hr. Significant numbers of counts also were detected in the kidneys, less in the spleen, and relatively few in the peripheral blood. These studies are the first to show that ^{99m}Tc can be used as a label to follow the organ distribution of both normal and neoplastic nucleated cells. The high specific activity, rapid labeling time, lack of release from dead and injured nucleated cells, and ready availability of the radionuclide are significant advantages which suggest that ^{99m}Tc may have wide applicability in both experimental and clinical studies of cell migration. (auth)

19094 IMPROVEMENT OF PANCREATIC IMAGING. Mattar, A. G.; Laor, Y. (Buffalo General Hospital). J. Nucl. Med.; 15: No. 8, 707-708(Aug 1974).

In the pancreas image study with the scintillation camera utilizing ^{75}Se-selenomethionine, optimal separation of pancreatic and hepatic images is achieved by examining the patient while he is lying on his right side with the detector head adjusted in an anterior oblique position, being tilted 10 deg cephalad as well as 10 deg toward the right side of the patient. Elevation of the pelvis on a pillow further accentuates this separation. (auth)

19095 BINDING OF ^{99m}Tc ION TO HEMOGLOBIN. Dewanjee, M. K. (Tufts Univ. School of Medicine, Boston). J. Nucl. Med.; 15: No. 8, 703-706(Aug 1974).

The mechanism and preferential site of binding of ^{99m}Tc ion to hemoglobin had been determined by the separation of ^{99m}Tc-hemoglobin from ^{99m}Tc-citrate and ^{99m}Tc-pertechnetate ion with a Sephadex G25 column. This purified fraction was analyzed by the HCl/acetone mixture to determine the ^{99m}Tc activity distribution with heme and globin. Most of the ^{99m}Tc activity is associated with

globin fraction. The preferred chain for ^{99m}Tc ion binding was determined by the splitting of ^{99m}Tc-hemoglobin with parachloromercuribenzoate solution followed by separation with a diethylaminoethyl cellulose column equilibrated with phosphate buffer. The ^{99m}Tc ion, like Cr^{3+} ion, tends to bind preferentially with the beta chain of hemoglobin. (auth)

19096 RADIONUCLIDE IMAGING OF THE KIDNEY IN TUBEROUS SCLEROSIS. Blatt, C. J.; Hayt, D. B.; Freeman, L. M. (Misericordia/Fordham Hospital Affiliation, Bronx, NY). J. Nucl. Med.; 15: No. 8, 699-702(Aug 1974).

Two patients, related to each other, are presented who have asymptomatic tuberous sclerosis. Tuberous sclerosis is a dominant, inherited neurocutaneous disorder that is clinically associated with mental retardation, epileptiform seizures, and characteristic skin lesions which are adenoma sebaceum. Utilizing radionuclide imaging techniques (^{197}Hg-chlormerodrin and ^{99m}Tc-pertechnetate tracer), multiple lesions of the kidney in one and a single lesion in the other were shown to be vascular rather than cystic in nature. Because of their known high association with tuberous sclerosis, renal angiomyolipoma was the primary consideration. This was proven with angiography. It is proposed that such nuclear medicine studies may offer diagnostic information in tuberous sclerosis with little hazard or inconvenience to the patient. (auth)

19097 IMAGING PATTERNS OF SUBDURAL HEMATOMA: A PROPOSED CLASSIFICATION. Sy, W. M.; Weinberger, G.; Ngo, N.; Sackler, J. P. (State Univ. of New York, Brooklyn). J. Nucl. Med.; 15: No. 8, 693-698(Aug 1974).

From Fall meeting of the Central Chapter of the Society of Nuclear Medicine; Indianapolis, IN (25 Oct 1973).

Eighteen patients with a total of 23 proved subdural hematomas presented four major discernible patterns on ^{99m}Tc-pertechnetate brain scan. A classification based on these patterns observed on the four conventional views is proposed. The various patterns of subdural hematomas were correlated with the clinical, radiographic, and surgical–pathologic findings. There were 13 instances of unilateral hematomas and 5 instances of bilateral lesions. Lesions showing a biconvex component as well as those of the band variety in general appear to correspond to older lesions. Lesions of the diffuse type appear to correspond to the early category. Unilateral lesions as a rule seem easier to discern on scan than bilateral ones. In the bilateral types the presence of a biconvex component is readily discernible on the straight projections and the corresponding lateral view may aid in its recognition. The bilateral band type should be suspected whenever both convexities appear unusually widened. The diffuse bilateral type appears to be more difficult to discern on scan. Delayed scanning is recommended in all patients clinically suspected of having subdural hematomas whenever the initial studies appear negative. (auth)

19098 ACROMEGALIC CHOLECYSTOMEGALY. Cohen, G. A.; Smoak, W. M.; Goldberg, L. D. (Mount Sinai Medical Center, Miami Beach, FL). J. Nucl. Med.; 15: No. 8, 720-721(Aug 1974).

Cholecystomegaly demonstrated by ^{131}I-rose bengal and ^{99m}Tc-sulfur colloid scintiscanning and radiographic techniques is described in a patient with proven acromegaly who presented with a right upper quadrant mass. This entity should be considered in evaluation of abdominal masses in acromegalic patients. (auth)

19099 FALSE-POSITIVE SCINTIGRAMS DUE TO MALPOSITION OF LIVER. Platthy, A.; Shah, U. (Woonsocket Hospital, RI). J. Nucl. Med.; 15: No. 8, 717-719(Aug 1974).

A ^{99m}Tc-sulfur colloid liver scintigram showed changes consistent with a space-occupying defect but that were due to malposition of the liver. (auth)

19100 LIPOMA OF THE CORPUS CALLOSUM. Addlestone, R.; Workman, J. B. (Duke Univ. Medical Center, Durham, NC). J. Nucl. Med.; 15: No. 8, 714-716(Aug 1974).

An intracranial lipoma of the corpus callosum is presented with a positive ^{99m}Tc-pertechnetate scan. Although a rare lesion, this diagnosis should be entertained with increased symmetrical anterior midline tracer activity. Most corpus callosum lesions will be malignant; however, a benign lipoma is an important consideration as the therapy would vary. (auth)

19101 LUNG SCAN IN THE DIAGNOSIS OF BRONCHOGENIC CARCINOMA. Didolkar, M. S.; Takita, H. (Roswell Park Memorial Inst., Buffalo). J. Surg. Oncol.; 6: No. 3, 225-229(1974).

When chest roentgenograms fail to reveal the presence of a lesion in a patient suspected to have bronchogenic carcinoma, perfusion lung scanning with ^{131}I-labeled macroaggregated human albumin is of great help in the diagnosis and localization of the bronchogenic carcinoma. Marked decrease in perfusion of the affected lung area is detected on lung scan in early hilar and parahilar lesions which are not even seen on chest roentgenograms. Two such cases are presented. Lung scanning is safe and easy to perform. (auth)

19102 RADIONUCLIDE ANGIOCARDIOGRAPHY IN CYANOTIC CONGENITAL HEART DISEASE. Hurley, P. J.; Strauss, H. W.; Wagner, H. N. Jr. (Johns Hopkins Medical Institutions, Baltimore, MD). Johns Hopkins Med. J.; 127: No. 1, 46-54(Jul 1970).

Radionuclide angiocardiography is a method of visualizing the heart, great vessels and lungs by observing the transit of a radioactive tracer with a gamma camera. This technique was used with ^{99m}Tc-pertechnetate as tracer to study 76 patients. Thirty of these had congenital cyanotic heart disease, 16 had no discernible heart disease and the remainder had acquired heart disease. The aim of the study was to investigate the usefulness of radionuclide angiocardiography in establishing or excluding the diagnosis of heart disease in the cyanosed patient. In all of the patients with congenital cyanotic heart disease, the radionuclide angiogram indicated an intracardiac right-to-left shunt. There were three false positive studies among the 46 others. Characteristic appearances for common cyanotic heart conditions were established. (auth)

19103 ON-LINE ANALYSIS OF CEREBRAL BLOOD FLOW CLEARANCE CURVE WITH ^{133}Xe. Kanno, I.; Uemura, K.; Yamaguchi, K. (Research Inst. of Brain and Blood Vessels, Akita, Japan). Iyo Denshi To Seitai Kogaku; 11: No. 5, 358-362 (Oct 1973). (In Japanese).

The analysis processing system consists of JEC 7 type computer, external memory apparatus, input apparatus, output apparatus, and parameter box. About 1 mCi each of ^{133}Xe physiological saline solution was injected into the carotid artery in the side of measurement. A clearance curve was obtained when (1) the subject was free from tolerance and (2) tolerance such as inhalation of 5% CO_2 gas, or artificial changes of arterial pressure was given. In the analysis of the clearance curve, "to," time datum-point when the blood begins to wash ^{133}Xe, was established and back-ground values were obtained to obtain blood flow using various formulae. In the height over area method, the difference between "Ho", the value in "to" and H_{10}, the value in t = 10 min was divided by the total of values from "to" to t = 10 to obtain the mean blood flow in 10 minutes. In the initial slope method, values in 2 minutes from "to" were subjected to logarithmic transformation to obtain the mean decade of the clearance curve, D, and using the distribution constant of the gray matter, λg, the blood flow was computed. In the compartment analysis method, supposing the clearance curve as the sum of two exponential attenuation curves, the measurement curve was simulated, and the blood flow of the component of the white substance of the gray matter was obtained from the approximate curve. The first two minutes of the clearance curve were subjected to logarithmic transformation and were shown in CRT. Noises in the present method are Poisson noise in the destruction of radioactive substances, noise occurring in the processing system, and artifact on measurement of the clearance curve. Countermeasures for each of them were described. In calculation the method of detection of "Ho" and "to" is complicated, and in the compartmental analysis, in relation to the evaluation of the agreement of approximate curve and measurement curve and the length of time for measurement of the curve, quantification in consideration of Poisson noise is required. These are problematic points. In analysis of more than 200 cases, the initial and height over area methods are fully reliable. (JA)

19104 SCINTIGRAM. Iio, M. (Tokyo Metropolitan Geriatric Medical Center); Toyama, H.; Chiba, K.; Iisaka, J. Nippon Rinsho; 32: No. 2, 326-331(Feb 1974). (In Japanese).

The movement of new imaging method in nuclear cardiology including digital color data processing method under exploitation by authors was summarized. Description was made as to a scanner which was an electronics machinery relating to imaging of the circulating system, gamma camera, and various data processing machinery. Radioactive drugs, of which half life used in heart scanning was extremely short, were tabulated. Heart muscle scanning which is advanced by using heart pool scanning, ^{134m}Cs and ^{201}Tl was noted. Illustration was made as to study cases expressed by two colors after smoothing by PHosdac of 35 mm continuing image taken every two seconds after intravenous injection of $^{99}TcO_4^-$ physiological salt solution. Furthermore, image of another case after 2 to 4 seconds of intravenous injection of $^{99}TcO_4^-$ physiological salt solution was expressed in red, that after 6 to 8 seconds, in yellow, and that after 14 to 16 seconds, green and yellow. Contrast enhancement of each image was made and each image was added and put into one image. This was illustrated. On the other hand, image after 2 to 4 seconds, that after 4 to 6, and that after 10 to 12 were expressed in purple, red and yellow, respectively, by using flying spot. They were collected into one image and illustrated. These images were the first step of synthesis and coloring of moving image by combination of computer and digital

color and were easy to identify. It was thought that these showed one direction of image process of the future isotope angiography. (JA)

19105 PRESENT SITUATION AND THE FUTURE OF SCINTIGRAPHY. Kaneko, M. (Nagoya Univ., Japan). Gendai Igaku; 21: No. 1, 31-35(Jul 1973). (In Japanese).

Seventeen organs subject for radioisotope imaging are mentioned, and radioactive medical supplies to be used, the dose, and the internally absorbed dose are tabulated. The features of ^{131}I and ^{99m}Tc are described. ^{131}I is suitable for treatment since it emits β rays but results in too large an exposure for examination. Its energy is too high for scinticameras. The majority of ^{99m}Tc emit β rays of 140 KeV and its half life is 6 hours, allowing mass administration with little exposure. With a satisfactory counting efficiency and easy protection, it is convenient for scinticamera examination. $^{131}I-Na$ and $^{99m}TcO_4$ are incorporated into the thyroid and excreted into the kidneys, saliva, and stomach. Since $^{99m}TcO_4$ is not absorbed by the intestinal tract, it is excreted with feces. $^{131}I-Na$ is mainly excreted from the kidneys. ^{99m}Tc is supplied as ^{99}Mo packed in generators, and its elution once a day is efficient. Since $^{99m}TcO_4$ and other ^{99m}Tc compounds are applicable to various organs, increase in the frequency of use is expected. A simple method of the ^{99m}Tc kit by electrolysis has been introduced. Preparation of $^{99m}Tc-Sn$ colloid by electrolysis and scintiphotographic cases were introduced. This method produces $^{99m}Tc-bleomycin$ and ^{99m}Tc-tri-polyphosphate also. Since the increased use of radioisotopes enhances internal absorption in operators (particularly on injection), protection and automatic radioisotope inhalators are needed. (JA)

19106 EFFECT OF GROWTH RATE ON THE GLUCOSE METABOLISM OF YEAST GROWN IN CONTINUOUS CULTURE. Radiorespirometric Studies. Mian, F. A. (Inst. of Microbiology, Prague); Fencl, Z.; Proko, A.; Mohagheghi, A.; Faeli, A. Bull. Astron. Inst. Czech.; 25: No. 3, 191-198(1974).

Specifically labeled ^{14}C-D-glucose was used to estimate the percentage participation of glycolysis and pentose phosphate cycle in the glucose catabolism of Candida utilis and Saccharomyces cerevisiae. The two yeasts were cultivated at various growth rates in a chemostat on synthetic medium limited with glucose under aerobic conditions. The results show a considerable increase in the percentage participation of pentose phosphate cycle in the glucose catabolized by Saccharomyces cerevisiae with the increase in specific growth rate. However, in Candida utilis, the specific growth rate does not influence significantly the part of glucose catabolized via pentose phosphate cycle, but its absolute values are relatively higher than in Saccharomyces cerevisiae. A rough quantitative estimate indicates that a maximum of 60 to 72% of the assimilated glucose is catabolized through the pentose phosphate cycle while in Saccharomyces cerevisiae the percentage participation of the pentose phosphate cycle varies from 24 to 60% (maximum) and 9 to 34% (minimum). (auth)

19107 DATA ON THE PHARMACOKINETICS OF NAFTAZONE-^{3}H. Delwaide, P. A. (Laboratoire de Chimie Medicale, Toxicologiee, et Hygiene, Liege); Heusghem, C.; Derouaux, G. Arch. Int. Pharmacodyn.; 208: 357-361(1974). (In French).

Two healthy subjects were given ^{3}H-naftazone intravenously and, two weeks later, by mouth. The time course of total radioactivity was measured in plasma and urine. The curves obtained were not fitted by exponential models, but were consistent with the assumption of a long term body retention of about 10 percent of the absorbed activity. The route of administration had little effect on the distribution of radioactivity. (auth)

19108 THE RADIOCALCIUM KINETICS IN THE DIAGNOSTICS OF THE AUTONOMOUS HYPERPARATHYROIDISM. Hehrmann, R.; Montz, R.; Schneider, C. (Hamburg Univ. (F. R. Germany). Abt. fuer Nuklearmedizin). Radiologe; 14: No. 5, 195-199(May 1974). (In German).

2 figs.; 3 tabs.; 22 refs.

The results of radiocalcium kinetics were compared in 4 groups of patients: healthy control persons, autonomous HPT, hypercalciuric osteoporosis, urolithiasis. From the parameters calcium accretion rate and quickly exchangeable calcium distribution space A, an index was calculated describing the relation between the alteration of both factors in HPT. The activity index may serve as a measure for the calcium metabolism and, with it, in the case of HPT as a measure for the effect of the parathormone and further for the function of the parathyroid. Patients with HPT are showing without exceptions higher values of the activity index than normal persons due to the regular increase of accretion rate and distribution space A. The index permits a delimitation of patients with HPT against patients showing the common sympton hypercalciuria in the case of osteoporosis or urolithiasis. The activity index of the radiocalcium kinetics proved to be a new and reliable criterium for the diagnostics of hyperparathyroidism. (GE)

19109 COMPARATIVE ANIMAL EXPERIMENTS CONCERNING THE DISTRIBUTION OF ^{99m}Tc-PYROPHOSPHATE, ^{99m}Tc-DIPHOSPHONATE AND ^{85}Sr. Buell, U.; Frey, K. W. (Muenchen Univ. (F. R. Germany). Klinik und Poliklinik fuer Radiologie); Balser, D. (Muenchen Univ. (F. R. Germany). Chirurgische Poliklinik). Fortschr. Geb. Roentgenstr. Nuklearmed.; 120: No. 4, 481-488(Apr 1974). (In German).

2 figs.; 4 tabs.; 19 refs.

^{85}Sr, ^{99m}Tc-pyrophosphate (n = 20), and ^{99m}Tc-diphosphonate (n = 8) were injected intravenously into 28 rabbits. The animals were killed one to three hours after injection and radioactivity was determined in blood, urine, kidneys, muscle, liver, thyroid, and in various bones. The ^{99m}Tc-phosphate compounds tended to be deposited more markedly in spongey bone than was the case for ^{85}Sr. Compared with ^{85}Sr, the most marked radioactivity differential for bone and muscle (target-non-target) and spongiosa and compacta was achieved by ^{99m}Tc-pyrophosphate. ^{99m}Tc-diphosphonate showed the most rapid muscle clearance, but three hours after injection lower bone activity than ^{85}Sr. Minimal radioactivity in the thyroid suggests good in vivo stability of the ^{99m}Tc-compound. ^{99m}Tc-pyrophosphate proved to be the best bone-seeking compound. (auth)

MATERIALS

Ceramics and Cermets

Refer also to abstracts 18232, 18378, 19299, 20361, 20362, and 20486.

19110 (AED-CONF-74-029-001) NEW METHOD FOR PREPARATION OF SINGLE PHASE CARBIDES AND NITRIDES (UC AND UN). Wedemeyer, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). 1974. 6p. (In German). INIS.

From conference on surface properties of ceramics; Erlangen, F. R. Germany (21 Feb 1974).

A new method, the "oxalate process", was suggested for the preparation of carbides and nitrides by carbothermal reduction of the corresponding oxide (taking UC or UN as example). It is based on that only freshly formed, very fine-grained metal oxides of a defined composition can be taken for carbothermal reduction. The oxides undergo thermal decomposition yielding the corresponding acido-compound, e.g. oxalate, immediately before the reaction, thus guaranteeing a maximum reactivity of the oxide and optimum low reaction temperatures while the following carbothermal reduction leads to powders which to a large extent maintain their sintering properties. (GE)

19111 (ANL-Trans-958) OXIDE–CERMET FUEL RODS: PRODUCTION, PROPERTIES, AND IRRADIATION BEHAVIOR. Weimar, P.; Zimmermann, H. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Material- und Festkoerperforschung). Jul 1974. Translation of KFK-1839. 48p. Dep. NTIS $5.50.

Cermets with idealized structure were produced by metallizing UO_2 spheres with Cr, V, or Mo by vapor deposition. The spheres were vibrated into the cladding tubes (Inconel 625 or Hastelloy X tubes in the case of UO_2–Cr). After electron beam welding of the tubes, the pins were isostatically hot-pressed in He atmosphere. The metal content of the cermets was 20 and 30%. Some properties of the UO_2–Cr, UO_2–V, and UO_2–Mo cermets are described. Seven irradiation capsules, one with UO_2–Mo, four with UO_2–Cr, and two with UO_2–V samples, were irradiated in the FR 2 reactor at mean rod powers of 470 to 700 W/cm and mean cladding temperatures of about 600°C to 10 to 95 MWd/kg U burnup. Each of the capsules contained eight or four fuel rod samples. UO_2–30 vol % Cr cermets with Inconel 625 cladding were irradiated to 60 and 95 MWd/kg U burnup without showing any failure. At these burnups the Hastelloy X claddings were probably damaged by microcracks. However, the temperatures of the Hastelloy X claddings were nearly 100°C higher than those of the Inconel 625 claddings. The high burnup UO_2–Cr samples with Inconel 625 or Hastelloy X cladding did not show dimensional changes in any case. The samples with 20% Cr showed a depletion of Cr in the fuel center region. Cr had been evaporated and condensed in the outer regions of the fuel. No such depletion was found in the cermet fuel with 30% Cr. The vanadium claddings of the UO_2–V cermets were damaged by many cracks in consequence of oxygen embrittlement during irradiation. It is suggested that UO_2–30% Cr fuel pins can be operated with linear rod powers of about 800 W/cm and cladding temperatures of 650°C to burnups of 60 MWd/kg U and probably more. A further increase of the rod power can be achieved only with a matrix metal having a lower vapor pressure. (28 figures, 5 tables) (auth)

19112 (BNWL-tr-116) DESIGN, IRRADIATION, AND EXAMINATION OF UO_2, PuO_2 FUEL PINS IN TEST DFR-304. Kummerer, K.; Geithoff, D. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Material- und Festkoerperforschung). 31 May 1974. Translation of KFK-1814. 125p. Dep. NTIS $9.25.

Results of fuel pin irradiation testing are reported. The fuel pins were irradiated in the Dounreay Fast reactor. Information is included on design, specifications, and sample production. The irradiation process is described along with nondestructive and ceramagraphic inspection. (JRD)

19113 (Juel-1038-HT) ON THE FAST NEUTRON FLUX INDUCED CHANGES IN THE MECHANICAL BEHAVIOUR OF COATED PARTICLES IN THE HIGH TEMPERATURE REACTOR (HTR). Baier, J. (Kernforschungsanlage Juelich G. m. b. H. (F. R. Germany). Projekt Hochtemperaturreaktor-Brennelmente; Technische Hochschule Aachen (F. R. Germany)). Jan 1974. 141p. (In German). INIS.

with figs. and tabs.; 89 refs. With abstract in German and English.

This study reports on fast neutron dose limits beyond which mechanical failure of pyrocarbon layers occurs with coated particle fuel. The influence of irradiation temperature, layer geometry, and structural parameters in the pyrocarbon on the lifetime of the particles is described. Results of irradiation tests in the BR2-Reactor (Mol, Belgium), DFR (Dounreay Fast Reactor, Scotland), FRJ2 (Juelich, German Federal Republic), R2 (Studsvik, Sweden), and in the Dragon Reactor (Winfrith, England) were evaluated and are interpreted. In the experiments, a fast neutron dose of more than 20×10^{21} cm^{-2}, E > 0.1 MeV, had been accumulated with temperatures ranging from 600 to 1,300°C. Particles fail at higher neutron fluence the lower the irradiation temperature. Geometrical factors such as layer sequence and layer thickness are of minor influence. Irradiated loose particles fail earlier than those pressed into graphite matrix. (orig)

19114 (MLM-2130(TR)) MEASUREMENT OF RESISTIVITY AND OXIDATION KINETICS IN PuO_{2-x}. Chereau, P.; Wadier, J. F. Translated by J. E. Selle from J. Nucl. Mater.; 46: No. 1, 1-8(1973). 14p. Dep. NTIS $4.00.

The electrical resistivity of PuO_{2-x} has been measured between $PuO_{1.77}$ and $PuO_{2.00}$ in the temperature range 700 to 1200°C, and it is concluded that the major defect species are anion vacancies. The kinetics of oxidation has been measured at 1080°C. The chemical diffusion coefficient of oxygen was computed, and the oxygen self-diffusion coefficient is derived as a function of the deviation from stoichiometry. (auth)

19115 SVOISTVA OKISLOV EVROPIYA. (Properties of Europium Oxides). Belyaev, R. A.; Bondarenko, V. V.; Vyskubov, V. P.; Kiparisov, S. S.; Lazarevskii, V. A.; Tyugin, V. M. Moscow; Atomizdat (1974). 52p.

Data on the uses, production, and properties of the known oxides of europium Eu_2O_3, EuO, and Eu_3O_4 were systematized. The crystallographic, thermodynamic, thermophysical, electrophysical, magnetic, mechanical, and chemical properties of these oxides and the radiation stability of the oxides and oxide-based dispersed materials were examined. (80 references, 22 tables, 34 figures) (tr-auth)

19116 DIELECTRIC AND STRUCTURAL PROPERTIES OF VACUUM DEPOSITED NIOBIUM OXIDE FILMS. Goswami, A. P.; Goswami, A. (National Chemical Lab., Poona, India). Indian J. Pure Appl. Phys.; 12: No. 1, 26-31(Jan 1974).

Niobium oxide films formed by vacuum evaporation of Nb_2O_5 were studied for their dielectric and structural properties. Dielectric constants of these films varying from 12–130 were found to be thickness dependent. Effects of frequency (10^2 to 10^5 Hz) and temperature (78 to 383°K) on capacitance and loss factor (tan δ) were also studied in detail. Tan δ showed a maximum and a minimum at 1 kHz with increasing temperature, but a minimum only with the frequency change. The structural study showed that the deposits formed at high temperatures developed two phases, viz. cubic (a = 5.38 Å) and tetragonal (a = 5.38 Å; c = 4.22 Å) growing epitaxially with appropriate orientations on (100) face of NaCl. These films were, however, amorphous at room temperature. The refractive index and extinction coefficient of these films were also measured. (10 fig. 24 references) (auth)

19117 EFFECT OF SiC ADDITION ON MICROSTRUCTURE OF WC–6% Co CEMENTED ALLOY. Park, W. K.; Eun, K. Y.; Hahn, B. H. J. Korean Inst. Metals; 11: No. 4, 355-360(1973). (In Korean).

WC and SiC powders were mixed, compacted, and vacuum heated; then they were recrushed to WC–SiC powders before addition to the cemented alloy. X-ray powder diffraction analysis was performed for the various WC–SiC powders. The (001) plane of tungsten carbide seemed to grow anisotropically in the WC–SiC powder which was vacuum heated to 1700°C. After mixing of the alloy powders, compacting and presintering, vacuum sintering for the WC–SiC-6% Co alloys was performed at temperatures between 1450 and 1550°C. It is considered that SiC promoted the anisotropic grain growth of tungsten carbide in the directions parallel to (001) plane and consequently angular carbide grains seemed to appear in the microstructure of the cemented WC–SiC–6% Co alloy. Either increasing SiC content or raising sintering temperature promoted the growth of α_1 and Co grains in the WC–SiC–6% Co alloy. (Korean Sci. Abstr.)

19118 STRUCTURES OF SOME TITANIUM–NIOBIUM OXIDES BY POWDER NEUTRON DIFFRACTION. Von Dreele, R. B.; Cheetham, A. K. (Oxford Univ.). Proc. Roy. Soc. (London), Ser. A; 338: No. 1614, 311-326(28 Jun 1974).

The structures of $TiNb_2O_7$ and ortho-$Ti_2Nb_{10}O_{29}$ were examined at 4.2°K by total profile analysis of powder neutron diffraction

data. The space group of $TiNb_2O_7$ is A2/m and the cell parameters are a = 11.890(5), b = 3.804(2), c = 20.373(9) Å, β = 120.199(3) deg. The final profile residual was 9.47%. The space group of ortho-$Ti_2Nb_{10}O_{29}$ is Amma and the cell parameters are a = 28.305(12), b = 3.780(2), c = 20.352(9) Å. A final profile residual of 10.62% was obtained. Substantial ordering of the cations among the different metal sites in these block structures was found, with titanium occupancy numbers varying from 14.0 to 64.5% for $TiNb_2O_7$ and from 4.5 to 40.0% in the ortho-$Ti_2Nb_{10}O_{29}$. The values are consistent with site potentials obtained on an ionic model. The oxygen positions were determined with greater precision than in previous studies of block structures, affording a detailed examination of the distortions around the crystallographic shear planes. (auth)

19119 ELECTRON DISTRIBUTION IN BN. Weiss, R. J. (Army Materials and Mechanics Research Center, Watertown, MA). Phil. Mag.; 29: No. 5, 1029-1032(May 1974).

The Compton profiles of cubic and hexagonal BN were measured with AgK α x-rays on polycrystalline samples and reveal a somewhat broader distribution in electron momenta for the cubic form. The structure factors for cubic BN were measured on a polycrystalline sample with monochromatic MoK α and CuK α. The values of the 111 and 200 structure factors (the latter is absent in diamond) reveal a significant change in the valence electron distribution as compared to a superposition of free-atom charge densities. Solid state theoretical structure factors are available for comparison (Euwema, R. N., Surratt, G. T., Wilhite, D. L. and Wepfer, G. G., 1974, Phil. Mag., 29, 1033). The Debye–Waller factor for cubic BN indicates an effective Debye temperature only about one half that of diamond (750°K compared to 1500°K) but this is consistent with specific heat measurements for diamond and cubic BN. The magnitude of the (420) structure factor suggests that the thermal mean-square displacement of the boron atoms is larger than that of the nitrogen atoms. (auth)

19120 DISORDERING OF A VANADIUM MONOXIDE SUPERSTRUCTURE BY ELECTRON IRRADIATION. Bell, P. S.; Lewis, M. H. (Warwick Univ., Coventry, Eng.). Phil. Mag.; 29: No. 5, 1175-1187(May 1974).

A 200-kV electron microscope was used to make an in-situ study of disordering by the electron beam of the superstructure $V_{244}O_{320}$ containing an ordered arrangement of vanadium vacancies. For electron accelerating voltages of 150 kV and above, the ordered structure is replaced by the cubic B1-type containing a random distribution of vanadium vacancies. It is shown that the disordering mechanism involves only the displacement of vanadium atoms by primary incident electrons, giving a value for the vanadium atom displacement energy of 7.8 eV. Observations of the relative rates of decay of the superlattice reflections during disordering show a correlation with the coordination of the vanadium atoms in the structure. A numerical calculation of the expected rates of decay is in good agreement with those observed. (auth)

19121 RAMAN EFFECT IN SINTERED CERAMICS. Chen, P. A. (Chung Shan Inst. of Science and Tech., Lung-tan, Taiwan). J. Amer. Ceram. Soc.; 57: No. 6, 275-276(Jun 1974).

CeO_2 and $BaTiO_3$ were used to show that Raman spectra of polycrystalline powders and sintered pellets are comparable to those of single crystals. Raman spectra of PbO, TiO_2 (anatase), and ZrO_2 powders are given. Raman spectra of mixtures of the composition $Pb(Zr_{0.53}Ti_{0.47})O_3$ were measured after sintering at 750, 1100, and 1260°C; results suggest that Raman spectra can be used to study the crystal structure and sintering reactions. (DLC)

19122 CONVERSION OF URANIUM HEXAFLUORIDE TO URANIUM DIOXIDE STRUCTURES OF CONTROLLED DENSITY AND GRAIN SIZE. De Hollander, W. R. (to General Electric Co.). US Patent 3,819,804. 25 Jun 1974. Filed Date 16 Jun 1971. 12p.

An integrated process for fabricating UO_2 structures of desired shape, density, and grain size from enriched UF_6 is presented. UF_6 is reacted with a reducing gas and an oxygen-containing carrier gas in a reduction-hydrolysis reaction in an active flame to yield a UO_2-rich powder of high surface area with fluoride impurities. The powder is separated from the gas stream after the reaction and is prepressed to a given shape by application of pressure and then broken into free flowing particles of a selected size range by granulation. Particles of powder outside the selected size range are screened out and can be combined with subsequent powder production for prepressing. The granulated powder is defluorinated by heating under a controlled atmosphere so that the high surface area of the powder is preserved. The defluorinated powder is then pressed into a structure of desired shape and sintered under a controlled atmosphere to yield a ceramic structure of desired density and grain size. The gas stream from the reaction of the UF_6 is treated to condense the hydrogen fluoride and water vapor as aqueous hydrofluoric acid. The process can be used with oxides of uranium of high surface area in any state of oxidation from UO_2 to U_3O_8 including uranium oxides produced by a postoxidation process converting the UO_2-rich powder to the higher oxide of uranium. (Official Gazette)

19123 PROPERTIES OF TANTALUM CARBIDE POWDER PRODUCED BY SYNTHESIS FROM ELEMENTS. Shvab, S. A.; Kislyi, P. S. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 5, 29-32(May 1974). (In Russian).

Tantalum carbide powder production by synthesis from powdered tantalum and carbon was investigated. The obtained powder corresponds to the stoichiometric composition. Changes in size, shape, bulk weight, and spillage weight after grinding were studied as affected by the period of grinding. (auth)

19124 PHASE EQUILIBRIUM IN THE $CuO-V_2O_5$ SYSTEM. Ivanova, Y. Y.; Dimitriev, Y. B.; Marinov, M. R.; Stravrakieva, D. (Inst. of Chemical Tech., Sofia). Compt. Rend. Acad. Bulg. Sci.; 27: No. 4, 491-494(1974).

Studies were made to determine the liquidus line and the primary crystallization fields in the $CuO-V_2O_5$ system. Endoeffects were observed in the DTA curves of melts crystallized from $CuO \cdot V_2O_5$, $2\,CuO \cdot V_2O_5$, and $3\,CuO \cdot V_2O_5$. X-ray diffraction, petrographic analysis, and microscopy were also used. Results were used to plot the probable phase diagram up to 90 mol % CuO. The eutecticum between $CuO \cdot V_2O_5$ and V_2O_5 is about 32.5 mol % CuO, while the solidus temperature is 630°C; in the remaining area, the diagram is not eutectic and may be considered as three incongruently melting compounds. (DLC)

19125 PHASE RELATIONS IN THE SYSTEM $SrO-Eu_2O_3-Fe_2O_3$ AND A NEW TERNARY PHASE Sr_2EuFeO_5. Drofenik, M.; Kolar, D.; Golic, L. (Univ. of Ljubljana, Yugoslavia). J. Less-Common Metals; 37: 281-284(1974).

$SrCo_3-Fe_2O_3-Eu_2O_3$ mixtures were pressed, calcined to decompose the carbonate, crushed again, re-pressed, and fired in air at 1300°C. The ternary compounds $SrEu_2Fe_2O_7$, $SrEuFeO_4$, and Sr_2EuFeO_5 were analyzed. Tie-lines between the ternary and binary phases were established. The mp of the ternary compounds was determined to be 1590, 1535, and 1540°C, respectively. The first two compounds have tetragonal lattices; Sr_2EuFeO_5 is also tetragonal, with a = 6.812 Å and c = 11.265 Å. (DLC)

19126 TEMPERATURE DEPENDENCE OF THE HARDNESS OF SIMPLE AND COMPLEX CARBIDES OF THE TRANSITION METALS. Chezhik, L. N.; Semenov, A. P.; Ferenets, V. Ya.; Tret'yakov, V. I.; Kushner, V. S. pp 82-87 of Temperaturnaya mikroskopiya Metallov i Splavov. Lozinskii, M. G. (Ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The hardness of the monocarbides TiC, ZrC, HfC, and WC and the alloys of carbides in the solid solution range TiC–WC, ZrC–WC, HfC–WC, TaC–HfC, HfC–TiC, and TaC–WC was studied in the temperature range from room temperature up to 950°C. The temperature dependence of the hardness of all the monocarbides studied in semilogarithmic coordinates represents two linear parts intersecting at a temperature around 400°C. A less intense decrease in the hardness was observed for the solid solution at high temperatures than for the monocrystals. (tr-auth)

19127 RECENT TREND OF NUCLEAR FUEL INDUSTRY IN JAPAN. Suzuki, S. (Japan Energy Economic Research Inst., Tokyo). Genshiryoku Kogyo; 19: No. 10, 37-41(Oct 1973). (In Japanese).

With the advance of nuclear power generation, nuclear fuel enterprises have come to be reality in Japan. However, the overall set-up of nuclear fuel industry has significant meaning. This is indicated by the recent emergence of another enterprise, i.e. Nuclear Fuel Industries, Ltd. in the domain of hitherto two companies, viz. Japan Nuclear Fuel Co., Ltd. and Mitsubishi Nuclear Fuel Co.; these are all fuel-fabrication enterprises. After reviewing the trends in this field in Japan, the situation involving these three companies is examined. JNF and MNF are closely tied up with respective nuclear reactor makers, JNF for BWRs and MNF for PWRs. While the future of NFI, which is independent unlike the other two, is fraught with difficulties, this start is to be taken as desirable for the sound development of the nuclear fuel industry. (JA)

19128 HARTREE–FOCK ELECTRON DISTRIBUTION OF CUBIC BN. Euwema, R. N.; Surratt, G. T.; Wilhite, D. L.; Wepfer, G. G. (Aerospace Research Lab., Wright-Patterson AFB, OH). Phil. Mag.; 29: No. 5, 1033-1039(May 1974).

The self-consistent crystalline Hartree–Fock x-ray structure factors and directional Compton profiles in the impulse approximation are given for cubic boron nitride. The first four structure

factors agree within experimental error with the measurements of R. J. Weiss (Weiss, R. J., 1974, Phil. Mag., 29, 1029). The calculated Compton profiles are tabulated for the 100, 110, 111, 112, and 221 directions. The calculated profiles are several per cent above the experimental profiles for small momentum transfer. The spread due to directional dependence is 5% at zero momentum transfer. (auth)

19129 ADSORBED GASES, ATMOSPHERIC, AND TEMPERATURE EFFECTS ON TSEE FROM BeO. Nagpal, J. S.; Gammage, R. B. (Oak Ridge National Lab., TN). Radiat. Eff.; 20: No. 4, 214-221(1973).

Oxygen, water vapor, and/or carbon dioxide adsorbed on ceramic BeO before or after irradiation profoundly affect the thermally stimulated exoelectron emission (TSEE). In their presence, the TSEE is dominated by a single peak at a surface temperature of ~275°C. Removal of these adsorbates by outgassing during readout causes the exoelectron emission to intensify with the TSEE curve becoming more complex. Apparently, sorption layers render inoperative certain traps effective for TSEE. Increased temperature during irradiation reduces the response (20% between 22 to 150°C). The influence of the gas surrounding the sample during irradiation was tested for the inert gases helium, nitrogen, neon, argon, and krypton using 5.6-keV, 22-keV, and 0.66-MeV photons. The enhancement in sensitivity for argon and krypton was much less than expected, which indicates that absorption of radiation in the volume of the solid is more important for excitation of the dosimeter than hitherto assumed. (auth)

19130 ANODE POLARIZATION AND PASSIVATION OF THE HETEROGENEOUS SYSTEM WC–Co. Filimonenko, V. N.; Kreichman, B. M.; Iskhakova, G. A. Fiz. Khim. Obrab. Mater.; No. 1, 143-146(1974). (In Russian).

Anode polarization of the heterogeneous system WC–Co in acid and neutral electrolytes was accompanied by passivation resulting from formation, with increasing anode potential, of oxide films first on the WC phase and then on the Co component of the alloy. The surface of the WC–Co alloy is activated by the anions OH^-, F^-, $Co_3^{=}$, and PO_4^{3-} and by conditions of continuous renewal of the electrode surface. Ultrasonic action in the interelectrode space decreased the diffusion limits. (tr-auth)

19131 CESIUM VANADOMOLYBDATE. Slobodin, B. V.; Mokhosoev, M. V.; Zvoleiko, P. T. (Donets State Univ., USSR). Zh. Neorg. Khim.; 19: No. 2, 388-392(1974). (In Russian).

Using differential thermal analysis data, a phase diagram was constructed for the $Cs_2MoO_4-V_2O_5$ system. The individuality of the chemical compounds $Cs_4Mo_2V_6O_{23}$, $Cs_4Mo_2V_{10}O_{33}$, and $Cs_2MoV_{10}O_{28.75}$ was confirmed by roentgenography and infrared spectroscopy. The last compound is an oxygen-vanadium-molybdenum bronze of cesium. The compounds formed are compared with the compounds of the $Cs_2O-V_2O_5$ system. (tr-auth)

19132 DEPENDENCE OF YIELD LIMIT OF HARD ALLOY WC–Co ON COBALT CONTENT AND TUNGSTEN CARBIDE GRAIN SIZE. Ivensen, V. A.; Eiduk, O. N.; Chistyakova, V. A. (All Union Scientific-Research Inst. of Refractory Metals and Hard Alloys, Moscow). Porosh. Met., Akad. Nauk Ukr. SSR; No. 5, 84-87(May 1974). (In Russian).

Based on the frame structure of the hard alloy phases, the method of mathematical analysis was suggested to study the dependence of the alloy yield limit on the cobalt content and grain size. The established dependences are confirmed by comparison with the experimental results of the authors and with Japanese data. (auth)

19133 HEATS OF TRANSFORMATION IN LANTHANIDE DICARBIDES AND MIXED LANTHANIDE DICARBIDE SOLID SOLUTIONS. Adachi, G. Y.; Ueno, K.; Shiokawa, J. (Osaka Univ.). J. Less-Common Metals; 37: 313-314(1974).

Heats of transformation were measured for the tetragonal–cubic transformation in LaC_2, NdC_2, GdC_2, TbC_2, DyC_2, ErC_2, and LaC_2-GdC_2 mixtures. Lattice parameters, transformation entropies, and strain energies are also given. (DLC)

19134 CuB_{24} SINGLE CRYSTALS. Higashi, I.; Takahashi, Y.; Atoda, T. (Inst. of Physical and Chemical Research, Wako-Shi, Japan). J. Less-Common Metals; 37: 199-204(1974).

Aggregates of single crystals were grown by cooling copper–boron melts from 1500°C to room temperature. The crystals have the chemical composition CuB_{24} and belong to the rhombohedral system of the space group R3m, R32, or R$\bar{3}$m. The measured density is 2.82 g/cm^3. It is concluded that the crystals are composed of $Cu_{4.3}B_{105}$ units per cell of lattice parameters $a = 10.190 \pm 0.001$ Å, and $\alpha = 65°14'$. The structural analogy between CuB_{24} and β-rhombohedral boron is discussed. (auth)

19135 MECHANISM OF DECOMPOSITION OF URANIUM OXYCARBIDES. Vlasov, V. G.; Larin, A. A. (Ural Polytechnic Inst., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 1, 97-100(1974). (In Russian).

Uranium oxycarbides dissociate with separation of CO_2 and metallic uranium (in the form of traces in the liquid phase). Increase in the decomposition rate with increase in the percentage of conversion of the oxycarbides appeared to be due to improvement in the conditions for release of CO_2 because of the influence of the liquid phase. The limiting role of different stages changed as the process progressed. The thermal stability was greater in the oxycarbides with a small content of oxygen, i.e., with a small quantity of defects. (tr-auth)

19136 JOINT SOLUBILITY OF C AND Nb IN Mo IN THE SOLID STATE. Zakharov, A. M. (Moscow Inst. of Steel and Alloys). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 1, 129-132 (1974). (In Russian).

Metallographic, x-ray, and electrographic analysis methods and measurements of the microhardness and melting point of alloys were used in studying the molybdenum angle of the ternary system Mo–Nb–C (up to 0.3% C and 3% Nb); isothermic cuts at 2100, 1600, and 1200°C and polythermic cuts of Mo–NbC and $MoNb_2C$ (from the Mo side) were made. Niobium decreased the solubility of C in Mo in the solid state. With less than 0.3 to 0.4% Nb, the solubility of C in Mo–Nb alloys was no more than 0.04% at 2100°C, 0.02% at 1600°C, and 0.01% at 1200°C. In all alloys studied, there was a phase of $(Mo,Nb)_2C$ (or solution of Nb in Mo_2C) in equilibrium with the molybdenum solid solution. Polythermic cuts of Mo–NbC and Mo–Nb_2C were not quasi-binary and did not coincide with the directions of the cones in the two-phase volume $\alpha + (Mo,Nb)_2C$. The maximum joint solubilities of Nb and C in these cuts (at 2240 to 2250°C) were around 0.44 and 0.06%, 0.85 and 0.05%, and sharply decreased with decreasing temperature. (tr-auth)

19137 INTERACTION BETWEEN THE MATRIX PHASE AND HARDENING ELEMENTS OF MATERIALS REINFORCED BY FIBERS. Frantsevich, I. N.; Karpinos, D. M.; Listovnichaya, S. P.; Fedorenko, V. K. pp 161-166 of Vliyanie Fiziko-Khimicheskoi Sredy na Zharoprochnost' Metallicheskikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

During forming and high-temperature annealing on the contact boundary of structural elements of fiber-reinforced materials a brittle intermediate phase was formed. The possibility of using a series of thin film coatings as a shield barrier was shown. This barrier to a significant degree slows down the mass transfer through the fiber–matrix boundary. The barrier-matrix contact zone is the weakest link in the system of reinforcing fiber–barrier–matrix. The temperature compatibility of the coatings studied with the structural elements was determined. The limiting compatibility temperature increases in the series SiO_2, mullite, titanium carbide, zirconium carbide, boron nitride, and aluminum oxide. (tr-auth)

19138 HIGH-TEMPERATURE OXIDATION OF METAL-LIKE COMPOUNDS OF TUNGSTEN (BORIDES AND SILICIDES). Lavrenko, V. A.; Frantsevich, I. N.; Glebov, L. A. pp 166-171 of Vliyanie Fiziko-Khimicheskoi Sredy na Zharoprochnost' Metallicheskikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The electrochemical theory of the heat resistance of metallic materials was used for the study of the oxidation processes of W_2B_5 and WSi_2 in oxygen at pressures of 0.1 to 740 torr in the temperature range from 800 to 1200°C. For the high-temperature oxidation of the boride and silicide in oxygen, the oxidation isotherm was calculated on the Mir-1 computer using a specially constructed program. An evaluation was made of the sublimation rate of the volatile oxides and of the parameters characterizing the relation of the metallic-like compounds to oxygen. The degree of continuity of the growing oxide layer was also evaluated. (tr-auth)

19139 RARE EARTH-COBALT BORIDES. Rogl, P. Monatsh. Chem.; 104: No. 6, 1623-1631(1973). (In German).

$YbCo_3B_1$, $PrCo_3B_1$ and $HoCo_3B_1$ have been prepared from the components. $YbCo_3B_2$ belongs to the ordered $CaCu_5$-type structure, $PrBo_3B_2$ and $HoCo_3B_2$ crystallize with the ordered $BaAl_3$-($ThCr_3Si_2$)-type structure. The crystal chemistry of the isotypic series of $RECo_3B_2$ as well as of $RECo_2B_2$ compounds is discussed. (Metals Abstr.)

19140 ELASTIC–PLASTIC BEHAVIOR OF TUNGSTEN CARBIDE–COBALT ANALYZED BY CONTINUUM MECHANICS. Sundstroem, B. O. Mater. Sci. Eng.; 12: No. 5-6, 265-276(1973).

Continuum mechanics, in particular the finite element method (FEM), are used to predict the elastic–plastic behavior of a two-phase composite material. WC–Co Alloys are used as an example. A FEM computer program for elastic–plastic analysis of two-dimensional problems in plane strain is applied to plate models, obtained from electron micrographs, which have been divided

into a pattern of triangular elements. The results show the importance of compatibility (continuity in deformation) for the analysis of heterogeneous materials. Agreement between calculated stress–strain behavior and experimental results taken from the literature is reasonable. A two stage mechanism for elastic–plastic deformation in WC–Co is proposed and some of the existing theories are discussed in the light of the results obtained. (Metals Abstr.)

19141 ADSORPTION OF GASES ON α–UO_3. Vlasov, V. G.; Shalaginov, V. N.; Beketov, A. R.; Ponomarev, V. F. (Ural Polytechnic Inst., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 1, 86-89(1974). (In Russian).

Adsorption of hydrogen, carbon monoxide, methane, water vapor, and carbon dioxide on α–UO_3 at high temperatures was studied. A good correlation was shown between data on gas adsorption and the kinetic characteristics of indirect reduction by different gases. (tr-auth)

19142 MAGNETISM AND MAGNETIC MATERIALS, 1973. Part 2. 19th Annual American Institute of Physics Conference, Boston, Massachusetts, November 16–18, 1973. Graham, C. D. Jr.; Rhyne, J. J. (eds.). AIP Conference Proceedings, Number 18, Part 2. New York; American Institute of Physics (1974). 699p. (CONF-731104-P2).

A separate abstract was prepared for each of thirty-three papers presented at the conference and included in Part 2. Two papers were previously abstracted in NSA as 29: 03045 and 29: 08186. Other papers presented in Part 2 are not in the scope of NSA. (JRD)

For abstracts of individual papers see: 19143–19147, and 19310–19337.

19143 NEW MAGNETIC OXIDES INVOLVING DIVALENT EUROPIUM AND TRANSITIONAL METAL IONS. Greedan, J. E. (Dalhousie Univ., Halifax Nova Scotia). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 749-753(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

New magnetic oxides have been synthesized in which both divalent europium and various paramagnetic ions are incorporated. These materials have the mixed perovskite structure given by $Eu(M^{2+}_{.5}M^{6+}_{.5})O_3$ and $Eu(M^{3+}_{.5}M^{5+}_{.5})O_3$. The number of possible combinations ($M_{.5}M'_{.5}$) is limited by the strong reducing tendencies of the Eu^{2+} ion in oxide lattices. Magnetic properties of Eu $(Mn_{.5}W_{.5})O_3$ and $Eu(Cr_{.5}Ta_{.5})O_3$ are reported. Both become ferrimagnetic at about 30°K with antiferromagnetic coupling between the Eu^{2+} and transition metal ion sublattices. (auth)

19144 FARADAY AND KERR EFFECT OF BISMUTH SUBSTITUTED IRON GARNETS: APPLICATIONS AND PHYSICAL ORIGIN. Wittekoek, S.; Popma, T. J. A.; Robertson, J. M. (Philips Research Labs., Eindhoven, Netherlands). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 944-948(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

Liquid phase epitaxy (LPE) films of bismuth substituted GdIG have been made with a high Faraday rotation and a compensation temperature near room temperature making them attractive for magneto optic recording. In films of composition $Y_{1.4-x}Lu_{1.4}Bi_xFe_5O_{12}$ an unusual high Bi concentration (molar fraction x = 0.7) and high Faraday rotation (6.7°/μm at 515 nm) have been realized. From Faraday- and Kerr-effect spectra in the uv the origin of the enhanced rotation is attributed to a charge transfer transition at about 370 nm. (auth)

19145 ANISOTROPY AND MAGNETOSTRICTION OF Pr^{3+} AND Nd^{3+} IN YIG. Krishnan, R.; Rivoire, M. (CNRS, Meudon-Bellevue, France). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1227-1231(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

Measurements of anisotropy and magnetostriction in $Y_{3-x}(^{Nd}_{Pr})_xFe_5O_{12}$ crystals with $0 \le x \le 0.03$ are presented. K_1 from both Pr^{3+} and Nd^{3+} is negative, the contribution from Nd^{3+} being higher than that from Pr^{3+}. For higher values of x, both λ_{100} and λ_{111} become strongly negative in these garnets. K_1/Nd is sensibly independent of x as expected for such low concentrations, whereas K_1/Pr shows a broad maximum near x = 0.01. Magnetostriction also shows a similar behavior for Pr. The above anomaly has been attributed to Pr^{4+}. (auth)

19146 CUBIC ANISOTROPIES IN SOME MIXED AND SUBSTITUTED RARE-EARTH GARNETS AT 77°K. Heilner, E. J.; Grodkievicz, W. H. (Bell Labs., Murray Hill, NJ). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1232-1236(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

The first and second order anisotropy constants, K_1 and K_2, have been measured in two series of bulk, flux grown garnets, $Y_{3-x}Sm_xFe_5O_{12}$ and $Y_{3-x}Sm_xScFe_4O_{12}$ at 77°K. In both series, the K_1 values are essentially linear with composition, with some departures from linearity at high Sm concentrations; while the K_2 values are quadratic with composition. The absolute values of K_1 and K_2 appear smaller for the Sc substituted series. The above results, in conjunction with previous work done on Pr and Nd garnets, indicate that the dependence of K_1 with composition becomes progressively more linear from Pr to Sm. (auth)

19147 SUITABILITY OF THE RARE-EARTH COMPOUNDS $Dy_2Ti_2O_7$ AND $Gd_3Al_5O_{12}$ FOR A LOW TEMPERATURE (4K-20K) MAGNETIC REFRIGERATION CYCLE. Flood, D. J. (Lewis Research Center, Cleveland). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1345-1348(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

Measurements have been made of the magnetic entropy and magnetization of powdered samples of the compounds $Dy_2Ti_2O_7$ and $Gd_3Al_5O_{12}$. The magnetization has been measured for temperatures at and below 4.2°K, in applied magnetic fields ranging to 7 Tesla. Isothermal changes in magnetic entropy have been measured for temperatures from 1.2 to 20°K, in applied fields up to 100 kilogauss. The results of the measurements are consistent with a doublet ground state for $Dy_2Ti_2O_7$, and an eight-fold degenerate ground state for $Gd_3Al_5O_{12}$. Absolute values of magnetic entropy have been obtained at the lower temperatures, permitting the isotherms to be properly located in the S-H plane with the use of adiabatic magnetization data. The iso-field lines in the S-T plane have been determined. The results indicate that $Dy_2Ti_2O_7$ can absorb a maximum of 71 ± 4 joules/kg of heat at 4.2°K, while $Gd_3Al_5O_{12}$ can absorb 233 ± 11 joules/kg at the same temperature. The large difference between the two is a result of crystal field interactions in the dysprosium compound. Both materials can be cycled adiabatically between 4.2 and 20°K. (auth)

19148 FORMATION OF TUNGSTEN AND MOLYBDENUM CARBIDES. Lewin, R. H.; Hayman, C. (to Fulmer Research Inst. Ltd.). US Patent 3,814,625. 4 Jun 1974. Priority date 8 Oct 1970, United Kingdom of Great Britain and Northern Ireland. 6p.

The method comprises effecting a vapor phase chemical reaction between (1) a metal hexafluoride, (2) a reactable hydrocarbon, and (3) hydrogen at 400 to 1000°C. The carbon to hydrogen ratio in the mixture is kept sufficiently low to ensure that no carbon is deposited as the required carbide is formed. The method is generally effected at reaction temperatures between 500 and 900°C. It is preferred that the reaction mixture consists of WF_6, benzene, toluene or xylene and hydrogen. The hydrocarbon however may be any one of a wide range of hydrocarbons that are vaporisable at the reaction temperatures and which will undergo reaction with the other components to produce the required carbide. By the method of the invention the carbide, especially tungsten carbide, can be applied to a wide variety of substrates such as the working surface of a steel tool or bearing or on carbon or boron fibers. (Official Gazette)

19149 NUCLEAR FUEL TABLET CONTAINING URANIUM CARBIDE, PLUTONIUM CARBIDE, AND PLUTONIUM NITRIDE, SULFIDE, OR PHOSPHIDE. Krauth, A.; Muller, N. (to NUKEM, GmbH). US Patent 3,813,344. 28 May 1974. Filed date 29 Sep 1971. 6p.

Nuclear fuels are prepared from uranium–plutonium–carbide or uranium–plutonium–nitride in which the fertile material (e.g., uranium carbide) and the fuel (plutonium carbide) are present arranged separately and the fuel (e.g., plutonium carbide) region has a higher and more open porosity than the fertile material (e.g., uranium carbide). (Official Gazette)

19150 IMPROVEMENTS IN OR RELATING TO COATINGS AND SHAPED BODIES. Deketelaere, E. C. (to Eugene Camille Deketelaere). British Patent 1,342,879. 3 Jan 1974. Filed date 30 Dec 1969. 7p.

Reference is made to processes for producing shaped bodies from particles or particle aggregates of ceramic materials, and particularly to processes for producing blocks, bricks, slabs, etc. Conventional processes have been found to possess certain disadvantages that are overcome in the process described. This process is based on the discovery that particles of certain ceramic materials form superficially a binding vitreous phase when heated at a suitable temperature. Immediately after the superficial vitri-

fication, it is subjected to rapid compression, vibration, or stamping in the warm state. It is thus possible to agglomerate the particles without the use of a binder, although a binder may also be used. The process may also be applied for making a shaped body of ceramic material from an ordinary refractory brick bonded with clay. The operation may be applied to an already baked refractory brick, and super-compression in the hot state imparts substantially better properties with regard to porosity, hardness, impermeability to gases, collapse characteristics, wear resistance, etc., and also suppresses casting defects. The same operations may also be carried out in the hot state on waste refractory bricks of fused material after mechanical crushing, without adding binder. Hot super-compression may be replaced in some instances by simple vibration in the hot or cold condition, with subsequent baking. Apparatus for the process is described. The process is applicable to either waste or new materials, including some clays. Examples are described, including application to ZrO_2, ThO_2, etc. Advantages of the process are enumerated. (UK)

19151 THERMOPHYSICAL PROPERTIES OF TRANSITION METAL CARBIDES AND DIBORIDES. Samsonov, G. V.; Bolgar, A. S.; Guseva, E. A.; Klochkov, L. A.; Kovenskaya, B. A.; Serebryakova, T. I.; Timofeeva, I. I.; Tuchanin, A. G.; Fesenko, V. V. (Inst. of Problems in Materials Science, Kiev). High Temp.–High Pressures; 5: No. 1, 29-33(1973).

From 3rd European conference on thermophysical properties; Turin, Italy (20 Jun 1972).

The enthalpy and specific heat of transition metal carbides were studied; the difference in the composition dependences of the specific heats of carbides of Group IV and Group V transition metals was established. The results are correlated with the thermal expansion of these carbides in the range 300 to 1200°K. The thermal expansion and thermal conductivity of diborides of Group IV to VI transition metals were studied in the range 300 to 2500°K. It was found that the thermal expansion increases, and the thermal conductivity decreases, in the order Group IV-V-VI transition metal diborides. It is shown that the thermophysical properties are mainly influenced by the statistical weight of boron and carbon atoms with sp configurations and also by the degree of stabilization of these configurations. In the case of pronounced delocalization of electrons participating in the sp configuration the factors that become important are the localization of electrons in the d^5 configuration and the density of excess unlocalized electrons in carbide and boride lattices. (auth)

19152 PLASTICITY OF POLYCRYSTALLINE UO_2 AT HIGH TEMPERATURES. Ferro, C.; Nuggeri, F. (Comitato Nazionale per l'Energia Nucleaire, Rome). High Temp.–High Pressures; 5: No. 1, 39-46(1973).

From 3rd European conference on thermophysical properties; Turin, Italy (20 Jun 1972).

Sintered uranium dioxide specimens were subjected to compression tests at temperatures of 1670 to 2400°K. At low stresses, the creep rate is given by a relationship of the form $\dot{\epsilon} = A\,\sigma^n \exp(-\Delta H/RT)$. The results obtained for viscosity are in agreement with the values obtained by other workers. (auth)

19153 INFLUENCE OF RADIATION ON THE ELECTRIC CONDUCTIVITY OF CERTAIN OXIDES OF THE RARE EARTH ELEMENTS AND YTTRIUM. Spitsyn, V. I.; Pirogova, G. N.; Stel'makh, N. S. (Inst. of Physical Chemistry, Moscow). Dokl. Phys. Chem.; 212: No. 4-6, 909-912(Oct 1973).

Translated from Dokl. Akad. Nauk SSSR; 212: No. 6, 1389-1392 (Oct 1973).

Y_2O_3, Nd_2O_3, Er_2O_3, and Pr_4O_7 were irradiated in a reactor at a flux of 1.2×10^{13} n/cm^2 · sec and the electrical conductivity was measured at temperatures from 100 to 400°C. A temperature dependence of the electrical conductivity was established for all the oxides. The specific resistance of the oxides is tabulated and shows that the change of temperature changes the volume resistance by several orders of magnitude. Irradiation increased the electrical conductivity of the oxides of Nd, Y, and Er, but with exposure the conductivity dropped. In the case of Pr_4O_7 the increase of electrical conductivity depended not only on the specific radioactivity but on the exposure of the sample after irradiation. The activation energy of the electrical conductivity was almost unchanged after irradiation in the high-temperature region. At lower temperatures there is a change most appreciable in samples with high specific radioactivity. There is also an increase of current carriers at low temperatures. (JSR)

19154 MECHANICAL EQUATION OF STATE AND HIGH-TEMPERATURE DEFORMATION ($\geq 0.5T_m$) OF URANIUM DIOXIDE. Roberts, J. T. A. (Argonne National Lab., IL). Acta Met.; 22: No. 7, 873-878(Jul 1974).

Stress relaxation experiments were performed on 8-, 15-, and 31-μm grain-size uranium dioxide (UO_2) in the temperature range 1400 to 1800°C ($0.5-0.7T_m$). The resulting stress–strain rate curves obeyed Hart's concept of the mechanical equation of state. Comparison of σ-$\dot{\epsilon}$ master curves for the three grain sizes showed that a wide regime of stress and strain rate is influenced by grain boundary sliding. Good agreement was found between stress relaxation and steady-state creep data. These results are discussed qualitatively in terms of existing models for plastic deformation of polycrystalline metals at elevated temperatures. (auth)

19155 IMPROVED VACUUM FURNACE FOR SINTERING CEMENTED CARBIDES. I. Brennan, H. F. Precis. Metal; 31: No. 10, 60; 62(Oct 1973).

Steps in the production of cemented carbides are described, and effect of Co content and grain size on hardness of straight WC–Co grades is shown. Sintering cycles are detailed. Final sintering is usually done in either batch or tunnel furnaces in a dry H atmosphere or in vacuum chambers. A recent technological advance is a vacuum furnace with graphite fiber internal surfaces which provides for H removal of paraffin and organic binders, presintering and final sintering. (Metals Abstr.)

19156 SHAPED NUCLEAR FISSIONABLE BODIES. Stern, G.; Roche, W. F. (to United Nuclear Corp.). US Patent 3,823,067. 9 Jul 1974. Filed Date 2 Aug 1971. 6p.

A process for producing fuel pellets for fuel rods is given which eliminates the thermal ratcheting effect. The fuel pellets are barrel-shaped, so that upon power cycling of the reactor, they assume a substantially cylindrical configuration. The process comprises introducing into the die cavity powders of different particle size so that after compacting and sintering, a barrel shape is produced. The particle size in the center is larger than at the ends. (DLC)

19157 FORMATION OF OXYCARBIDES DURING THE OXIDE TREATMENT OF CEMENTED CARBIDE TOOLS. Naik, S. K.; Suh, N. P. ASME Publication No. 73-WA/Prod-16. New York; American Society of Mechanical Engineers (1973). 4p.

Reactions between oxides and carbides were investigated to establish enhancement mechanisms occurring during the oxide treatment of cemented carbide tools. TiO powder was compacted around solid WC and TiC specimens which were then heated to 1400°C in a vacuum of 10^{-4} to 10^{-3} torr. The reactions of Al_2O_3 with these carbides was similarly investigated. X-ray diffraction analysis shows that oxycarbides formed on the carbide surface during the oxide treatment. Discussions are given with regard to how these oxycarbides may enhance the metal cutting properties of cemented carbide tools. (Metals Abstr.)

19158 MAGNETIC SUSCEPTIBILITY STUDY OF URANIUM AND RARE EARTH TUNGSTEN BRONZES: EXCHANGE AND CRYSTAL FIELD EFFECTS. Thomas, J. F. Ithaca, NY; Cornell University (1973). 134p. University Microfilms Order No. 74-6359.

Thesis (Ph. D.).

Magnetic interactions in magnetically dilute rare earth and uranium tungsten bronzes have been investigated by Faraday susceptibility studies in the temperature range of 1.6 to 300°K. The bronzes, general formula M_xWO_3, where M = U, Pr, Nd, Gd, Dy, Tb, Ho, Er and $0.09 \leq x \leq 0.15$, were prepared by solid state reaction in vacuo at 1030°C for periods of twenty-five to forty hours. Conduction-electron-mediated antiferromagnetism, as reported by Ostertag (Inorg. Chem., 8, 1373 (1969)) in the uranium tungsten bronzes, was not detected in these studies. Instead weakly concentration-dependent Weiss constants ($65 < \theta < 130$°K, valid for the range $77 < T < 300$°K) were observed for a series of thorium-diluted uranium tungsten bronzes, $U_xTh_{0.1-x}WO_3$, x = 0.01, 0.05, 0.10. Analogy with similar behavior in thorium-diluted uranium dioxide, $U_xTh_{1-x}O_2$, suggests triplet ground state crystal field interactions in the uranium tungsten bronzes as well. Available crystal field calculations do not provide good quantitative fits of the magnetic data, but the observed temperature dependencies of susceptibility for Pr_xWO_3 and Nd_xWO_3 qualitatively follow behavior expected for singlet and doublet ground states of Pr^{3+} and Nd^{3+}; however, Weiss constants ($\theta = -89 \pm 2$°K for Pr_xWO_3 and -108 ± 5°K for Nd_xWO_3 for the range $150 < T < 300$°K) are significantly larger than those generally observed. The heavy rare earth tungsten bronzes showed no indications of antiferromagnetism but followed Curie–Weiss laws with nearly concentration-independent Weiss constants: $\theta = -0.6$ for $Gd_{0.12}WO_3$; -3.0 ± 1.0°K for Tb_xWO_3, -5.7 ± 0.5°K for Dy_xWO_3, -8.7 ± 0.8°K for Ho_xWO_3 with x = 0.12 and 0.15 and $15 < T < 80$°K; $\theta = -21 \pm 4$°K for Er_xWO_3 with x = 0.09, 0.12, 0.15 and $75 < T < 300$°K. Near independence of the Weiss constants of conduction electron density and rare earth magnetic content at values comparable to those found in insulating rare earth compounds suggests that the Curie–Weiss behavior is a

manifestation of crystal field interactions, not as indication of magnetic exchange effects. (Diss. Abstr. Int., B)

19159 IMPROVEMENT OF THE TECHNOLOGY OF FINISHING NIOBIUM-CONTAINING PRODUCTS. Tarasova, T. B. Tsvetn. Metal.; No. 4, 76-77(Apr 1974). (In Russian).

After a preliminary annealing of the crude concentrate in a reducing medium at 800°C for 30 min, the extraction of Nb_2O_5 into the working concentrate is 93.4%. (tr-auth)

19160 HIGH TEMPERATURE PROCESSING OF SUPER-REFRACTORIES IN A PLASMA FLUID BED REACTOR. Bonet, C. (Centre National de la Recherche Scientifique, Montlouis, France); Vallbona, G.; Foex, M.; Daguenet, M.; Dumargue, P. Rev. Int. Hautes Temp. Refract.; 11: No. 1, 11-24(Jan 1974). (In French).

A plasma fluid bed reactor for reprocessing super-refractories at high temperature is described. The study of treatment is made in the case of zirconia processing. The results of measurements show that fluidization of a part of the powder is efficient, but in order to interpret the high evaporation rate of zirconia, the thermal shock of material due to the monoclinic reversible tetragonal transformation must be taken into account. Consequently, there is a sensitive increase in specific area and evaporation rate. With stabilized zirconia, melting and spheroidization of material occur. Vapor from lime-stabilized zirconia is partly destabilized. (FR)

19161 ELECTRICAL CONDUCTIVITY OF SINTERED URANIUM DIOXIDE. Stiglic, R.; Stevanovic, M. (Boris Kidric Inst. of Nuclear Sciences, Vinca, Yugoslavia). Tehnika (Belgrade); 26: No. 3, 67-80(1972).

The room-temperature electric conductivity of UO_2 samples sintered in H_2 at 1100-1560°C was measured. Results are discussed with respect to the change of porosity, microstructure, and oxygen content. (Bull. Sci., Sect. A.)

19162 CONDITIONS AND MECHANISM OF SUBOXIDE FORMATION IN THE SYSTEM TANTALUM-OXYGEN. Kornilov, I. I.; Dekanenko, V. M.; Vavilova, V. V. (Inst. of Metallurgy, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 11, 1737-1742(Nov 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 11, 1957-1963(Nov 1973).

In the Ta-O system, two suboxides (Ta_4O and Ta_2O) are segregated from supersaturated solid solutions at 300-1000°C. The suboxide Ta_2O is observed at 500-1000°C. It coexists with a solid solution, the lattice period of which varies from 3.310 to 3.314 Å. Segregation of suboxides with these compositions is due to the difficulty of rearrangement of the bcc lattice of tantalum to the Ta_2O_5 lattice with a lower symmetry at relatively low temperatures. Decomposition of the supersaturated solid solution of tantalum with oxygen is accompanied by formation of a series of tantalum suboxides. (auth)

19163 EFFECT OF TITANIUM ON STABILIZATION OF NIOBIUM SUBOXIDES. Kornilov, I. I.; Dekanenko, V. M.; Vavilova, V. V. (Inst. of Metallurgy, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 11, 1743-1746(Nov 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 11, 1964-1968(Nov 1973).

Alloying Nb with Ta to the extent of 2 at. % increases the maximal O content of the solid solution after quenching from 6 to 8 at. %. The oxygen content of the solid solutions after annealing at 500 and 700°C is 7 and 6 at. % respectively. Decomposition of the solid solution during annealing is accompanied by segregation of NbO as an excess phase at 700°C or above, and by segregation of Nb_2O when the annealing temperature is 500°C. After annealing at 300°C, the neutron-diffraction patterns of the alloys exhibit considerable broadening of the niobium lines; this may be due to decomposition of the supersaturated solid solution with formation of a suboxide of the Nb_6O type. This unusual behavior of O in Nb with 2 at. % Ti must affect the mechanical properties of Nb-Ti alloys with higher O content. (auth)

19164 INFRARED SPECTRA AND ELECTROPHYSICAL PROPERTIES OF LANTHANUM METANIOBATE. Sych, A. M.; Dem'yanenko, V. P.; Nekrasov, M. M.; Zastavker, L. A.; Eremenko, L. A. (Kiev State Univ.). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 11, 1728-1731(Nov 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 11, 1947-1950(Nov 1973).

According to its ir spectra in the region 2000-30 cm^{-1}, La metaniobate (La_xNbO_3) crystallizes with the perovskite structure in the tetragonal system. The temperature dependence of the conductivity, the dielectric constant, and the loss angle tangent was studied at 20-300°C. The residual charge from polarization of La metaniobate is $(4.5-8.0) \times 10^{-4}$ C/cm^2. Polarization of La_xNbO_3 leads to marked nonuniformity of the internal field and to changes in all the dielectric properties. (auth)

19165 CALCULATION OF THE PHASE FIELD BOUNDARIES IN THE IDEAL- AND REGULAR-SOLUTION APPROXIMATIONS IN THE SYSTEMS Ln_2O_3-MgO. Ogorodnikova, A. A.; Lopato, L. M. (Inst. of Problems in Materials Sciences, Kiev). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 11, 1723-1727(Nov 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 11, 1940-1946(Nov 1973).

The liquidus curves in the systems Ln_2O_3-MgO (Ln = La, Nd, Sm, Gd, Dy, Y, Er, Tm, Yb, Lu, Sc) was calculated in the ideal-solution approximation. The discrepancy between the experimental and theoretical curves increases with the atomic number of the lanthanides, owing to deviation of the systems from ideality. The phase-equilibrium curves of the systems Ln_2O_3-MgO were calculated with the aid of the regular-solution model; the results confirmed the applicability of the theory of regular solutions to this class of oxide systems. (auth)

19166 ENTHALPY AND THERMAL CAPACITY OF Dy_2O_3 AND β-Ga_2O_3 AT HIGH TEMPERATURES. Tsagareishvili, D. Sh.; Gvelesiani, G. G. (Inst. of Metallurgy, Tbilisi, USSR). Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 11, 1719-1722(Nov 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 11, 1936-1939(Nov 1973).

The enthalpy of Dy_2O_3 and β-Ga_2O_3 was measured at 298.15-1600°K by the method of mixing. Interpolation equations of the temperature dependences of the enthalpies and thermal capacities of these compounds were derived. The confidence intervals of the smoothed values of these functions were calculated. Results agree closely with literature data. (auth)

19167 EROSION REGULARITIES FOR BORIDES OF 4 TO 6TH GROUP TRANSITION METALS UNDER ELECTRIC SPARK ALLOYING. Sychev, V. S. Elektron. Obrab. Mater.; No. 1, 31-32(1973). (In Russian).

The erosion of anodes from borides of the transition metals of the 4-6 groups during electric spark alloying was studied. On an example of alloying Nb and Mo cathodes, it was shown that the erosion of the anode is reduced during transition from the borides of the 4th group to borides of the metals of the 5th group and then to 6th group borides. It was established that the erosion of the borides used as anodes during electric spark alloying was determined to a significant degree by their brittle fracture. Results are discussed with the position of the model of configurational location of valence electrons. (tr-auth)

19168 CHEMISORPTION OF HYDROGEN ON NEODYMIUM OXIDE. Slovetskaya, K. I.; Dmitriev, R. V.; Rubinshtein, A. M.; Minachev, Kh. M. (Inst. of Organic Chemistry, Moscow). Bull. Acad. Sci., USSR, Div. Chem. Sci. (Engl. Transl.); 22: No. 12, 2622-2624(Dec 1973).

Translated from Izv. Akad. Nauk SSSR, Ser. Khim.; 22: No. 12, 2685-2689(Dec 1973).

Activated molecular reversible chemisorption of hydrogen at 150 to 400°C is observed on neodymium oxide, evacuated at 480°C. The chemisorption complex is stable in air. When Nd_2O_3 is heated in hydrogen above 500°, there is a reduction of Nd^{3+} to Nd^{2+}. (auth)

19169 COLOR CENTERS IN GAMMA-IRRADIATED, RARE EARTH, ALUMINUM GARNETS ACTIVATED WITH Cr^{3+} AND Mn^{3+} IONS. Arsen'ev, P. A.; Ibragimova, E. M. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk. Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 1, 44-46(1974). (In Russian).

Studies were made on the absorption spectra of gamma-irradiated crystals of dysprosium and yttrium aluminum garnets activated with Cr^{3+} and Mn^{3+} ions. In this additional absorption bands were detected at 500 mm as a result of the formation of the Cr^{2+} ion and at 470 and 640 mm because of the formation of Mn^{4+} ion. (SJR)

19170 MODULATED STRUCTURE IN THE TANTALUM-NITROGEN SYSTEM. Trenzinger, K.; Jung, P.; Schilling, W. (Kernforschungsanlage, Juelich, Ger.). Acta Met.; 22: No. 8, 937-943(Aug 1974).

In tantalum samples containing more than about 1.2 at. % N, diffuse "side-bands" occur in the x-ray scattering pattern during annealing. They show for the first time in an interstitial system a precipitate structure which can be described by the zone model suggested by Guinier for substitutional alloys like Cu-Ni-Fe. By investigations of the x-ray patterns, the dependence of the precipitate structure on nitrogen content and aging temperature was determined. Results are confirmed by electron microscopy and resistivity measurements. (auth)

19171 GRAIN GROWTH IN Mo-AlN METALLO-CERAMIC ALLOYS IN ANNEALING. Alfintseva, R. A.; Bozhko, S. A. Izv. Akad. Nauk SSSR, Metal.; No. 2, 195-198(1974). (In Russian).

The kinetics of agglomerate recrystallization of metallo-ceramic Mo and its alloys containing 0, 0.5, 1, 4, and 8 vol % AlN was stud-

ied. With increasing AlN content, the rate of grain growth increased. (tr-auth)

19172 LANTHANUM–MOLYBDENUM–BORON AND LANTHANUM–TUNGSTEN–BORON SYSTEMS. Svarichevs'ka, S. I.; Kuz'ma, Yu. B. Visn. L'viv. Derzh. Univ., Ser. Khim.; No. 14, 24-27(1972). (In Ukrainian).

X-ray analysis was used to construct the equilibrium diagram for the La–{Mo,W}–B systems at 800°C. No ternary compounds or significant amounts of binary boride-based solid solutions were detected. The LaB_6 boride is in equilibrium with the borides $\{Mo,W\}_{2-x}B_3$, $\{Mo,W\}_2B_5$, and {Mo,W}B; the LaB_6 boride is in equilibrium with {Mo,W}B and La is in equilibrium with $\{Mo,W\}_2B$. (16 references) (Ref. Zh.)

19173 THERMAL AND ELECTRICAL CONDUCTIVITIES OF LaB_6 AT HIGH TEMPERATURES. Tanaka, T. (National Inst. for Researches in Inorganic Material, Ibaraki, Japan). J. Phys., C (London); 7: No. 9, L177-L180(7 May 1974).

The thermal diffusivity and the electrical resistivity of LaB_6 were measured at high temperatures from 1300 to 2000°K. An analysis of the data indicated that the Wiedemann-Franz law was not obeyed in this temperature range. The discrepancy arises because of the relatively high lattice thermal conductivity. The observed lattice conductivity is 3.5×10^{-2} cal cm^{-1} $s^{-1}°K^{-1}$ at 1300°K, which is in good agreement with the calculated value. (auth)

19174 PROCESS FOR THE PREPARATION OF URANIUM DIOXIDE AND THE PRODUCT PRODUCED THEREBY. Robins, R. G.; Edenborough, B. W. Australian Patent 14,860. 18 Nov 1971. Filed date 20 May 1969. 21p.

A process is described for the production of uranium dioxide by reducing an acid solution of a uranyl salt or uranyl salts in the temperature range 60 to 300°C, with a carbohydrate. (orig/edit)

19175 INFLUENCE OF THE LOADING MODE ON THE ZIRCONIUM CARBIDE HIGH TEMPERATURE CREEP. Zubarev, P. V.; Dement'ev, L. N. Probl. Prochnosti; No. 8, 61-64(Aug 1973). (In Russian).

The effect of the type of load on creep of small-grain Zr carbide at 2150 to 2630°C and a tension of 0.2 to 2.0 kg/mm^2 is presented. In the presence of stress, shrinkage, and bending, the creep curves agreed with each other except the portions of accelerated creep; the type of load did not affect the creep mechanism. The idea is expressed that creep is controlled by diffusion processes at the grain boundaries. (tr-auth)

19176 INFLUENCE OF POROSITY ON THE CREEP OF NIOBIUM CARBIDE AND OTHER POWDER MATERIALS AT UNIAXIAL LOADING. Kats, S. M.; Ordan'yan, S. S.; Gorin, A. I.; Kudryasheva, L. V. Probl. Prochnosti; No. 7, 84-88(Jul 1973). (In Russian).

The effect of 5 to 35% porosity on creep in free uniaxial loading of niobium carbide at temperatures of 2250 to 3200°K and stress of 1 to 5 kg/mm^2 was studied. Results agreed well with an analytical relation expressing the effect of porosity on creep of powder materials in uniaxial loading and different indexes of the degree of creep. (tr-auth)

19177 REDUCTION OF THORIA BY CARBON. Djemal, M.; Dode, M. (Paris Univ., Orsay, France). Rev. Int. Hautes Temp. Refract.; 11: No. 1, 29-33(Jan 1974). (In French).

The study of the reduction of thoria by carbon was carried out with mixtures containing low percentage of carbon. Two new domains were found: the first one (bivalent) corresponds to the formation of $ThO_{2-x}C_x$, and the second one (monovariant) to the equilibrium between $ThO_{2-x}C_x$, ThO_2, and ThC. (FR)

19178 EFFECT OF ADDITIONS OF METAL SILICIDES ON TITANIUM AND ZIRCONIUM BORIDES FROM THE POINT OF VIEW OF THEIR SINTERING BEHAVIOR AND THEIR RESISTANCE TO OXIDATION AT HIGH TEMPERATURE. Pastor, H.; Meyer, R. (Ugine Carbone, Grenoble, France). Rev. Int. Hautes Temp. Refract.; 11: No. 1, 41-54(Jan 1974). (In French).

Composite materials, offering a much higher resistance to oxidation at high temperature than pure borides, were investigated through the presence of a protective coating of vitreous borosilicate. Samples were prepared, either by conventional sintering (compacting at 6kbar followed by sintering in vacuum or in argon at a temperature above the melting temperature of silicide), or by hot compacting at 2kbar and a temperature in the vicinity of the melting point of silicide. The density, loss in weight, chemical composition, structure (photomicrography, x rays), resistance to oxidation in air at 1200°C for 100 hours, and nature of the oxidized layer were determined. (FR)

19179 GROWTH AND PURIFICATION OF STABILIZED ZIRCONIA CRYSTALS BY HORIZONTAL ZONE MELTING IN SELF-CRUCIBLE. Giroud, G.; Vitter, G.; Deportes, C. (Ecole Nationale Superieure d'Electrochimie et d'Electrometallurgie, Grenoble, France). Rev. Int. Hautes Temp. Refract.; 11: No. 1, 25-28(Jan 1974). (In French).

A zone melting process for high melting oxides is described. It consists in a rf heating by direct induction in a multitubular horizontal crucible. Results for stabilized zirconia are given. (FR)

19180 OXYGEN SOLUBILITY IN ZIRCONIUM CARBIDE AT 1555°C WITH FREE CARBON AND IN THERMODYNAMICAL EQUILIBRIUM CONDITIONS. Ouensanga, A.; Dode, M. (Paris Univ., Orsay, France). Rev. Int. Hautes Temp. Refract.; 11: No. 1, 35-39(Jan 1974). (In French).

At 1555°C, in the bivariant range $ZrC_yO_x - C - CO$, the oxygen content of zirconium carbide ZrC goes from $0.0 < O/Zr < 0.013$ to $0.040 < O/Zr < 0.065$ when the carbon monoxide pressure increases from a few millimeters to the monovariant ($ZrC_yO_x - ZrO_{2-x} - C - CO$) equilibrium pression, 300 mm Hg. The dissolution of oxygen is accompanied by a decrease of the lattice parameter of the oxycarbide from 4.696 to 4.688A. (FR)

19181 SOLUBILITY OF Nb_2O_5 IN FUSED METAPHOSPHATE-FLUORIDE SYSTEMS. Grigorenko, F. F.; Slobodyanik, N. S.; Nagornyi, P. G.; Fedoruk, T. I. (Kiev State Univ.). Ukr. Khim. Zh.; 40: No. 5, 451-453(May 1974). (In Russian).

The solubility of Nb_2O_5 in $LiPO_3$–LiF at 850°, $NaPO_3$–NaF at 1000°, and KPO_3–KF at 850° was studied by the isothermal method. It was shown that in the metaphosphate-fluoride systems in the temperature limits from 850 to 1000°C significantly larger solubility of Nb_2O_5 is attained than in the pure metaphosphates of Li, Na, and K. This indicates extreme chemical interaction of Nb_2O_5 with the solvent components. (tr-auth)

Metals and Alloys

Refer also to abstracts 18384 and 20412.

19182 MODERN DEVELOPMENTS IN POWDER METALLURGY. Volume 7. P/M Forging and Copper P/M. Proceedings of the 1973 International Conference Held at Toronto, Canada, July 15–20, 1973. Hausner, H. H.; Smith, W. E. (eds.). Princeton, NJ; Metal Powder Industries Federation (1974). 635p. (CONF-730718-P7). $37.50.

Thirty papers presented at the conference are included in volume 7. A separate abstract was prepared for each of eight papers selected for inclusion in NSA. (JRD)

For abstracts of individual papers see: 19237 and 19338–19344.

19183 SINTERED COBALT–NEODYMIUM–SAMARIUM INTERMETALLIC PRODUCT AND PERMANENT MAGNETS PRODUCED THEREFROM. Martin, D. L. (to General Electric Co.). US Patent 3,821,035. 28 Jun 1974. Filed date 1 May 1972. 10p.

Novel sintered cobalt–rare earth intermetallic products are used to form permanent magnets having unique properties. The sintered product is comprised of intermetallic compounds of cobalt and rare earth metals composed of samarium and neodymium. Cobalt is present in an amount of about 62 to 66 wt % and the rare earth metals are present in an amount of about 34 to 38 wt % with the neodymium component ranging from about 20 to 90 wt % of the rare earth content. Permanent magnets are formed from the sintered product in bulk form or in particulate form. (Official Gazette)

Corrosion and Erosion

19184 INFLUENCE OF LANTHANUM AND YTTRIUM ON THE CORROSION RESISTANCE OF CHROMIUM IN NITRIC ACID. Tavadze, F. N.; Mikadze, O. I.; Rudoli, A. P.; Mandzhgaladze, S. N. Soobshch. Akad. Nauk Gruz. SSR; 66: No. 3, 625-628(1972). (In Russian).

The influence of La and Y at 20 and 100° was determined. At 20° and whatever the structure, Cr was in the stable passive state in concentrated HNO_3, and the state was maintained on alloying with up to 0.68% La and 0.28% Y. Corrosion at 100° depended on the structural state, extruded Cr being in the stable passive state while melted Cr corroded with an initial rate of 0.62 mm/year. La and Y act as anodic inclusions and undergo selective leaching into electrolyte. (Corrosion Abstr.)

19185 MICROSTRUCTURE AND PROPERTIES OF SPECIAL METAL COATINGS APPLIED BY THERMAL SPRAYING. Steffens, H. D.; Mueller, K. N.; Kayser, H. (AFAM, Bremen, Ger.). Werkst. Korros.; 25: No. 3, 166-171(Mar 1974). (In German).

Almost nonporous, impermeable sprayed coatings can be obtained by spraying in enclosed protective gas chambers. Thus,

corrosion-resistant special metals (or less common metals) with a high affinity towards O and N may be processed. Ti, Ti alloys as well as Nb, Mo, and Zr can be used as materials for oxygen-free, almost nonporous sprayed coatings with high adhesion. By means of light and electron-optical examinations, it is shown that Ti coatings for example, applied by electric arc spraying, are of sufficient density and homogeneity. Furthermore, x-ray diffraction analyses demonstrate that sprayed Ti coatings applied under extra-pure Ar, are free of any impurity phases. The properties of the sprayed coatings can be strongly influenced by the gas atmosphere. Potentiokinetically obtained current density/potential curves clearly show that the titanium coatings sprayed under an atmosphere of extra-pure Ar do not differ from the nontreated base material in their electrochemical behavior. Addition of reactive gases to the protective gas atmosphere will lead to intermediary phases which in turn will affect the electrochemical behavior due to local microelements. The considerable differences in the electrochemical behavior observed in TiAl6V4 coatings, sprayed under extra-pure Ar, are due to a structural heterogeneity caused during the spray process. This leads to a reduction of the corrosion resistance which is further reduced by the presence of reactive gases such as nitrogen or oxygen in the protective gas atmosphere. Apart from this marked loss of corrosion resistance of Ti and TiAl6V4 coatings, the adhesion of these coatings is likewise reduced considerably when they are applied under a mixed atmosphere of N and Ar. (DLC) (GE)

19186 OXIDATION OF Cr–Y ALLOYS. Bobrovskii, A. V.; Vasyutinskii, B. M.; Kartmazov, G. N.; Lazareva, L. S. (Physical-Technical Inst., Kiev). Ukr. Khim. Zh.; 40: No. 2, 165-168(Feb 1974). (In Russian).

Literature data (9 refs) on oxidation of Cr–Y alloys were analyzed, and the kinetics of the oxidation at 1200°C were studied for alloys with 0.05 to 35 at. % Y. The residual electrical resistance of some of the alloys was measured. (tr-auth)

19187 SURFACE NITRIDING OF VANADIUM. Samsonov, G. V.; Kaplina, G. S. Zashch. Pokrytiya Metal.; No. 5, 80-83 (1971). (In Russian).

The nitriding of electrolytic V in a medium of commercial N, previously freed from O and moisture, and also in high-purity N is described. In the nitriding of V a nitride of the VN type is formed, and underneath this is a layer comprising an α solid solution of N in V. The growth of the layer obeys a parabolic time law and is limited by the diffusion of N through the reaction products. The microhardness of the VN layer is 1850-1960 on the outside and 1400-1500 kg/mm^2 on the inside. The microhardness of the solid solution falls smoothly on moving away from the nitride layer. The activation energy for the diffusion of N in the nitride is 19 kcal/mole. (Metals Abstr.)

19188 REACTIVE DIFFUSION DURING THE OXIDATION OF TUNGSTEN ALLOYS IN AN ATMOSPHERE WITH A HIGH NITROGRN CONTENT. Lazareva, I. Yu.; Prokoshkin, D. A.; Vasil'eva, E. V.; Skotnikov, S. A. Zashch. Prokrytiya Metal.; No. 5, 47-50(1971). (In Russian).

The oxidation of alloys of W with Ti, V, Nb, Ta, and Re (up to 50 wt% of each) was studied in air and in N-enriched air (over 700 torr partial pressure), and the composition of the oxidation products was determined. Using a special spectral technique, the amount of N dissolved in the alloy scale was measured. The rate of oxidation of alloys with Ti, V, Ta, and Nb increased with increasing N partial pressure. This change was attributed to an increase in the diffusion permeability of the oxides so formed as a result of the development of anion vacancies in these due to their dissolution of N which is more electronegative than O. (Metals Abstr.)

19189 INTERACTION OF ALLOYS OF THE NIOBIUM–MOLYBDENUM SYSTEM WITH NITROGEN. Zhunkovskii, G. L.; Kaplina, G. S. Zashch. Pokrytiya Metal.; No. 6, 174-176 (1972). (In Russian).

The interaction of a series of alloys of the Nb–Mo system with N under conditions of diffusion saturation (holding for 8 h at 1000 to 1300°C) was studied by metallographic analysis, x-ray diffraction (phase analysis), and microhardness measurements. The rate of the interaction, the phase composition, and the microhardness of the reaction products and of the parent metal varied considerably with the initial composition of the alloy. Over the temperature range studied, the interaction of these alloys (particularly those containing 35 to 60% Mo) with N took place ~10 times as rapidly as in the case of the pure metals. (Metals Abstr.)

19190 CORRELATION BETWEEN ACOUSTIC EMISSION DURING SCC AND FRACTOGRAPHY OF CRACKING OF THE ZIRCALOYS. Cox, B. Corrosion; 30: No. 6, 191-202(Jun 1974).

The fractography of all transgranular stress corrosion cracking (SCC) failures of the Zircaloys is generally similar and consists of areas of cleavage separated by regions of ductile tearing. Minor differences arise due to processes which occur after the crack front has passed (i.e., due to etching in some environments). Major differences are apparent between room temperature and high temperature (200 to 400°C) fractures in the nature of the ductile process which interconnects the regions of cleavage. Two types of acoustic emission have been recorded during SCC tests: (1) A continuous swishing noise, which control experiments have shown to arise either from electrochemical noise or from dislocation generation during plastic deformation, and (2) a discontinuous, cracking noise, which may result from either brittle crack propagation, oxide film cracking, or twinning. Since neither type of acoustic emission can be related uniquely to a single process which is occurring, its value in the SCC of hexagonal metals is apparently limited. (auth)

19191 B-Nb_2O_5 FORMATION AND RELEVANT PHENOMENA OBSERVED DURING OXIDATION OF A Nb–2.5 AT. % Mo ALLOY. Yamawaki, M.; Kanno, M.; Mukaibo, T. (Tokyo Univ.). J. Less-Common Metals; 37: 257-268(1974).

Nb–2.5 at. % Mo alloy shows an anomalous parabolic-to-plateau-like type weight-increase behavior during oxidation at around 835°C. For a further study of this behavior, x-ray and thermogravimetric methods were used. The x-ray study showed that the allotropic transformation of Nb_2O_5 from the T-form to the B-form and, further, to the M-form occurs in the oxide scales during oxidation of the alloy. It was shown that during the plateau-like stage of the reaction, B-Nb_2O_5 is the dominant constituent of the outer part of the scale, indicating that the B-Nb_2O_5 crystals constitute a barrier for the diffusion of oxygen through the scale. The results of the measurement of the structural changes along the depth direction of the scales formed on the alloy suggested that the B-to-M transformation is probably accelerated by the stress. The formation of a large amount of B-Nb_2O_5 in the scale was accompanied by a change in the apparent reaction scheme from the NbO_2-forming type to the NbO/NbO_2-forming type. (5 fig) (auth)

19192 ANODIC DISSOLUTION OF COPPER–ZINC, SILVER–ZINC, AND SILVER–CADMIUM ALLOYS. Marshakov, I. K.; Bolychev, V. S.; Potapova, O. P. (Voronezh State Univ., USSR). Prot. Metals (USSR) (Engl. Transl.); 9: No. 1, 1-6(1973).

Translated from Zashch. Metal.; 9: No. 1, 3-9(1973).

A rotating disk electrode and ring were used to determine the mechanism of decomposition (dissolution) of alloys of the Cu–Zn, Ag–Zn, and Ag–Cd systems in 0.5 N NaCl, 0.1 N H_2SO_4, 0.1 N HCl, and 0.1 N KNO_3. Conclusions regarding the dissolution of the alloys, based on their electrochemical behavior, correlate satisfactorily with the results of disk-electrode tests. (auth)

19193 INFLUENCE OF ALLOYING ADDITIONS ON CORROSION RESISTANCE OF TITANIUM. Tomashov, N. D.; Ruskol, Yu. S.; Ayuyan, G. A.; Ivanov, Yu. M.; Plavnik, G. M.; Nazarova, R. I. (Inst. of Physical Chemistry, Moscow). Prot. Metals (USSR) (Engl. Transl.); 9: No. 1, 7-11(1973).

Translated from Zashch. Metal.; 9: No. 1, 10-15(1973).

A method of potentiostatic polarization curves, corrosion tests, and electron diffraction measurements were used to determine the effects of Nb, Cr, Sn, Mn, Al, and Mo alloying additions on corrosion and electrochemical properties of titanium. It was shown that these additions have no effect on the basic structure of passivating oxide films or on the partial and full passivation potentials. Mechanisms of the influence of these elements on the corrosion resistance of titanium and on the threshold passivation currents were postulated. (auth)

19194 CORROSION RESISTANCE OF NICKEL–MOLYBDENUM–TUNGSTEN ALLOYS. Nikandrova, E. A.; Maslenkov, S. B. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Prot. Metals (USSR) (Engl. Transl.); 9: No. 1, 32-33 (1973).

Translated from Zashch. Metal.; 9: No. 1, 40-42(1973).

The alloys N65M20V15 (Ni–16.5W–19.6Mo) and N55M20V25 (Ni–25.7W–19.4Mo) are dispersion-hardening alloys. When hardened, the structure of N65M20V15 consists of γ-solid solution and the structure of the N55M20V25 consists of $\gamma + \alpha$-solid solution. Aging at 600 to 900°C greatly increases the hardness by precipitating the intermetallic phase $Ni_4(Mo,W)$. The total corrosion resistance of alloys heat-treated to maximum hardness (quenching from 1000°C in water, tempering at 800°C for 5h) was determined in 5 to 90% solutions of sulfuric acid and in 5 to 37% solutions of hydrochloric acid at 20, 60, and 90°C and at boiling point. The test duration was 100 h. The dependence of corrosion resistance on heat-treatment conditions and tendency to intercrystalline corrosion were determined by boiling specimens for 240 h in a 21% HCl solution. The total corrosion of the N55M20V25 alloy was found to be slightly higher than that of other alloys. In HCl solutions the

alloys showed a good corrosion resistance at 60 and 90°C. In sulfuric acid solutions at boiling point the alloys showed a satisfactory corrosion resistance only to 25% of H_2SO_4. Alloys N65M20V15 and N55M20V25 showed no tendency to intercrystalline corrosion either in the high-temperature (1200 to 1300°C) or in the low-temperature region. The rate of total corrosion of N65M20V15 alloy reaches a maximum after tempering at 900°C while in the case of N55M20V25 it has a minimum at 800°C and a maximum at 1000°C. (auth)

19195 CORROSION OF THE CARBIDES OF TRANSITION METALS IN A GLOW DISCHARGE PLASMA. Kuznetsov, G. D.; Babad-Zakhryapin, A. A.; Lagutkin, M. I. (Moscow Inst. for Steel and Alloys). Prot. Metals (USSR) (Engl. Transl.); 9: No. 1, 77-79(1973).

Translated from Zashch. Metal.; 9: No. 1, 83-86(1973).

The interactions of the monocarbides of niobium, tantalum, and zirconium in helium and hydrogen glow discharge plasmas were studied. It was found that the reaction between a medium based on helium and hydrogen and niobium and tantalum carbides, under the conditions of a glow discharge, leads to the decarbonization of a surface layer with a thickness of 25 μm for niobium and of 20 μm for tantalum. Decarbonization of zirconium carbide occurs within the limits of the region of homogeneity. (JRD)

19196 ELECTROCHEMICAL BEHAVIOR OF INDIUM. V. The Influence of Acidity and Stirring on the Cathodic Process. Pohel'nikov, A. P.; Losev, V. V. Elektrokhimiya; 9: No. 7, 1031-1033(Jul 1973). (In Russian).

Combined electrochemical and radiochemical measurements were made on a rotating In electrode in $HClO_4$ (3×10^{-3}-1M) + $NaClO_4$ solutions at a constant ionic strength of 3M. Although the rate of discharge of In was inversely proportional to the $HClO_4$ concentration over the range studied, the rate of H evolution increased with $HClO_4$ concentration above 5×10^{-2} M and in the most acid solutions was faster than the discharge of In ions. Hence the simultaneous evolution of H was not reflected in the kinetic laws governing the discharge of In ions. The relatively low dependence of the cathodic process on stirring indicated that the limiting current for the discharge of In ions was not under diffusion but under kinetic control. (Metals Abstr.)

19197 PROTECTION OF NIOBIUM AND TANTALUM FROM CARBURIZATION. Zhunkovskii, G. L.; Evtushok, T. M. Zashch. Pokrytiya Metal.; No. 5, 169-172(1971). (In Russian).

The use of boride diffusion layers on Nb and Ta, as barriers aimed at preventing the carburization of the base, was studied. The temperature limits to t stability of such boride layers, in contact with various C-cont...ing media, were determined in this connection. Typical temperatures for the onset of undesirable interactions lay between 1600 and 1900°C, depending on the phase constitution of the protective layers and the microstructure of the base, as governed by its initial working and heat treatment. The interaction between the coating and the base was the determining factor in this respect, the critical temperature being governed by the kinetics of the action at the interface. (Metals Abstr.)

19198 OXIDATION OF TANTALUM AND TANTALUM ALLOYS. Stringer, J. (Univ. of Liverpool). Rev. High-Temp. Mater.; 1: No. 3, 256-346(1973).

The information available on the Ta-O system is discussed; some information on the Ta-N system is also included. After a summary of diffusion data, the oxidation of Ta in O_2 is discussed in detail, with emphasis on the high-temperature reaction. Oxidation in other atmospheres is considered briefly. Finally, the oxidation of Ta alloys is reviewed; data are presented in tables and graphs. (30 fig, 127 references) (DLC)

19199 KINETICS OF SELECTIVE ANODIC DISSOLUTION OF URANIUM FROM ZINC ALLOYS UNDER POTENTIOSTATIC CONDITIONS. Gol'dshtein, S. L.; Nichkov, I. F.; Raspopin, S. P.; Smirnov, G. B. (Ural Polytechnic Inst., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 1, 69-72(1974). (In Russian).

Potentiostatic equipment was used in studying the diffusion kinetics of selective anodic dissolution of uranium from its alloys with zinc in molten equimolar mixtures of potassium and sodium chlorides at 700 and 800°C. Damping of the current in the potentiostatic anodic refining of zinc-uranium alloys followed the Lingane equation only with an established diffusion regime in the molten metal (final part of the current-time curve). With depletion of the alloy, continuous growth of the thickness of the diffusion layer in the liquid metal was observed. The initial part of the potentiostatic current curve contains information on the value of the limiting current of selective ionization of uranium from its alloys with zinc, related to the initial composition of the dissolving composition. The values found agreed satisfactorily with the results of polarization current measurements. (tr-auth)

19200 EFFECT OF THE AIR COMPONENTS ON THE HEAT RESISTANCE OF REFRACTORY METALS OF THE VIA GROUP. Larikov, L. N.; Tyshkevich, V. M. pp 21-27 of Vliyanie Fiziko-Khimicheskoi Sredy na Zharoprochnost' Metallicheskikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

A study was made by thermogravimetric methods of the mechanism and kinetics of the interaction of Mo, W, and Cr with the components of the air. It was established that at different temperature intervals the oxidation of Mo is subject to different laws. It was established that during the oxidation of monocrystals of Mo and W different crystallographic planes are oxidized at different rates. The effect of plastic deformation on the oxidation was clarified. The effect of alloying Cr with Y on the interaction of Cr with O_2 and N_2 of the air was also studied. The interaction of different alloys of Mo and W with the O_2 of the air was studied. (tr-auth)

19201 REGULARITIES IN THE CORROSION OF MOLYBDENUM ALLOYS IN A FLOW OF COMMERCIAL INERT GAS. Dushin, Yu. A.; Solomko, Yu. V.; Petrovskaya, I. D. pp 28-33 of Vliyanie Fiziko-Khimicheskoi Sredy na Zharoprochnost' Metallicheskikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The changes in the mechanical properties and structures of refractory metallic materials during use in high temperature inert gas were evaluated as a function of gas contamination and input rate of the impurities from the gas flow. The characteristic equilibrium and kinetic corrosion regimes were determined. The boundaries of the transition zone were established. The effects of the type of inert gas, of the mass velocity, and of the gas temperature on the corrosion rate of Mo alloys were examined experimentally. For the alloy Mo-0.07 wt % Zr-0.02% C, the consequences of corrosion in argon with oxidizing or reducing components were studied. The experimental results in conjunction with data from thermodynamic calculations for the system Mo-Zr-(Ti)-O-N-C-H made it possible to evaluate the limiting period for its use in different gasdynamic installations. (tr-auth)

19202 EFFECT OF RARE EARTH METALS ON THE KINETICS AND MECHANISMS OF THE CORROSION OF NICKEL-CHROMIUM BASED ALLOYS. Ignatov, D. V.; Lazarev, E. M.; Abramova, N. B. pp 68-72 of Vliyanie Fiziko-Khimicheskoi Sredy na Zharoprochnost' Metallicheskikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The oxidation of the alloys Ni-10% Cr, Ni-10% Cr-6% Mo, Ni-10% Cr-6% W, and Ni-10% Cr-15% Co with 0.2 wt % additions of Y, La, and Ce and without these additions was studied at 1000 and 1100°C for 100 h. The effect of Y on the kinetics and mechanisms of the oxidation of the alloys was studied for an extended period (1000 h) at 1100°C. It was shown that in these alloys the oxidation rate is significantly reduced by the introduction of rare earth metals. (tr-auth)

19203 STRUCTURAL STATE OF SURFACE LAYERS AND PROPERTIES OF HEAT RESISTANT METALS WORKING IN CONTACT WITH AN OXIDIZING MEDIUM. Filatova, M. A.; Maksimov, A. I.; Anisimova, M. A.; Belolipetskii, Yu. P.; Maslenkov, S. B.; Zimina, L. N.; Topilin, V. V.; Stepanov, V. P.; Tsvetkova, V. K. pp 77-80 of Vliyanie Fiziko-Khimicheskoi Sredy na Zharoprochnost' Metallicheskikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The efficiency of the blade material of stationary gas turbine installations depends first of all on the stability of the surface layers of the metal in contact with the gaseous medium. The possibility of increasing the efficiency of the surface layers of metals by alloying was examined. In particular the alloying of Ni heat resisting alloys with Nb and Co leads to a decrease of the oxidation rate and a decrease of the depletion of the surface layers of the alloys in the gas current at increased temperature (800 to 850°C) in conjunction with a decrease of the rate of the diffusion processes. The structure of the material is changed; it becomes stable. Auxiliary properties were improved. (tr-auth)

19204 EFFECT OF ALLOYING ELEMENTS AND COMPONENTS OF THE AIR ON THE HEAT RESISTANCE OF ALLOYS BASED ON METALS OF THE IV GROUP. Voitovich, R. F.; Golovko, E. I. pp 81-87 of Vliyanie Fiziko-Khimicheskoi Sredy na Zharoprochnost' Metallicheskikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The heat resistance of alloys of Ti, Zr, and Hf with Fe, Co, Ni, and Cu was studied in air at temperatures from 600 to 1200°C. As a function of the valency and the ionic radius the alloying element causes an increase, a decrease, or a complete disappearance of the density of condensed vacancies in the scale. The effects of sintering the scale include the development of holes on the internal boundaries and other changes. The effect of nitrogen from the air on the oxidation processes of these alloys was examined. It was

shown that at temperatures up to 800°C, when the formation of the scale occurs on the internal boundaries, nitride phases are not detected because of the reduced solubility of nitrogen (greater dimension of its atoms than the oxygen atoms and much smaller donor capacity). The free energy for the formation of the nitride phase is also much smaller in comparison with the oxides of the corresponding metals. (tr-auth)

19205 INTERACTION OF CHROMIUM-BASED ALLOYS WITH AGGRESSIVE MEDIA. Fesechko, P. F. pp 131-136 of Vliyanie Fiziko-Khimicheskoi Sredy na Zharoprochnost' Metallicheskikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The effect of alloying with Mo, W, Fe, Co, B, Nb, V, Al, Ti, Ni, Sr, Zr, C, and N on the stability of Cr-based alloys in Sn melts, on the heat resistance in a medium of high-temperature rapid flow of combustion products with O_2 additions, and alkali metals, in contact with annealed cement clinkers, and during hot compression of ferrites was examined. The stability of pure Cr in Sn melts was determined. The elements reducing the stability and the elements increasing it were indicated. Cr-based alloys having a high stability in Sn melts at high temperature, heat resistance, unweldability with cement clinkers, and no interaction with ferrites during hot compression were found. (tr-auth)

19206 ANODIC DISSOLUTION OF W IN CHLORIDE AND CHLORIDE–FLUORIDE MELTS. Manenkov, M. I.; Shkol'nikov, S. N. (Krasnoyarsk Inst. of Nonferrous Metals, USSR). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 1, 65-68(1974). (In Russian).

Anodic dissolution of W in chloride and chloride–fluoride melts was studied with current densities of from 5×10^{-3} to 1 A/cm^2. In the chloride melts the W ions migrated with an average valence of 4.06 to 4.21, and in the mixture, with a valence greater than 5 and increasing with increasing current density. Anodic polarization of W was studied in the two melts at current densities of from 1×10^{-4} to 3.0 A/cm^2. (tr-auth)

19207 GROWTH KINETICS, IDENTIFICATION, AND STRUCTURAL BEHAVIOR OF OXIDE LAYERS ON U–0.2% V AND U–0.2% Cr ALLOYS IN A MEDIUM HAVING A pH OF 13. Pommier, G.; Jouve, G.; Aucouturier, M.; Lacombe, P. (Paris Univ., Orsay, France). Compt. Rend., Ser. C; 278: No. 11, 745-748(11 Mar 1974). (In French).

Information available on electrolytically pure uranium was completed by studies of the effects of the addition elements, chromium and vanadium, in a sodic medium having a pH of 13. Results do not demonstrate any fundamental differences to those obtained with pure metals. (FR)

19208 ACOUSTIC EMISSION AND STRESS-CORROSION CRACKING OF U–4 1/2 wt.-% Nb. Magnani, N. J. Exp. Mech.; 13: No. 12, 526-530(Dec 1973).

Stress-corrosion propagation in U-4 1/2 wt% Nb was monitored with crack-opening displacement and acoustic-emission techniques. Excellent correlation was obtained between the direct crack-velocity measurements and the emission count rate at all stress intensities. The data also show that, as the cracking velocity increases, the counts per unit area of new crack surface increase. The results of the investigation show the feasibility of acoustic-emission detection techniques as a useful stress-corrosion testing tool. (Metals Abstr.)

19209 ALUMINIZED ALLOY BOOSTS TURBINE BLADE LIFE. Gedwill, M. A.; Grisaffe, S. J. (Lewis Research Center, Cleveland). Metal Progr.; 106: No. 3, 66-68(Aug 1974).

Duplex coatings with improved high-temperature oxidation resistance combined with some strain resistance. First, a ductile, oxidation-resistant alloy overlay, such as NiCrAl(Si, Y), is applied to the blade (IN-100) by cladding, vapor deposition, or plasma spraying. The overlay's surface is then converted to an aluminide by park cementation, metallizing, or hot dipping. Oxidation and corrosion tests have been conducted at temperatures up to 1,090°C. (DLC)

19210 STRESS CORROSION CRACKING OF WELDED JOINTS IN HIGH STRENGTH STEELS. Gooch, T. G. (Welding Inst., Abington, Cambridge, Great Britain). Weld. J. (N. Y.); 53: No. 7, 287s-298s(Jul 1974).

From fifty-fifth AWS annual meeting; Houston, TX (6 May 1974).

Variables affecting stress corrosion cracking (SCC) were studied. It was found that the SCC susceptibility of high strength steels may be greatly increased by welding, especially if marked hardening occurs in the heat affected zone (HAZ) or weld metal as a result of the weld thermal cycle. If postweld heat treatment is applied so that the hardness of the weld area is restored to that of base metal, there will be no significant loss in SCC resistance of the assembly. If such heat treatment is not applicable, increased susceptibility must be anticipated in the transformed HAZ, and in matching composition weld metal. The susceptibility of welded high strength steels to SCC is primarily dependent on the microstructure produced in the different weld areas. Susceptibility generally increases with increasing hardness, while the presence of twinned martensite in particular is deleterious. SCC can take place intergranularly with respect to prior austenite grain boundaries, or in a transgranular manner by cleavage or microvoid coalescence. Highest susceptibility arises with intergranular failure. With the particular alloys studied, highest SCC resistance was found with low carbon precipitation hardening materials. If tempered at high temperature to similar hardness levels, medium carbon low alloy grades will be generally comparable with precipitation hardening systems, and the former materials may be preferable if marked pitting attack is likely in service. The presence of alloy element segregation and inclusions may reduce the SCC resistance of high strength steel weld metal, but such effects are of secondary importance compared with that of microstructure. The adverse effect of segregation may be most marked in high alloy precipitation hardening steels. The stress concentration at a weld toe does not significantly affect the corrosion processes causing SCC initiation in low alloy steels in neutral chloride media. Such stress concentrations can, however, localize attack in high alloy materials and promote SCC initiation at the weld toe. Thus, while fracture mechanics tests can be used to give comparative data on resistance to crack propagation, conventional tests on uncracked samples are essential to define the risk of SCC initiation taking place by a corrosion mechanism in service. Consideration has been given to the risk of SCC in different environmental conditions. Other work has indicated that SCC in marine conditions will not occur in material softer than 400 VHN: the present results on high strength steels are in accordance with this finding. However, it is considered that this critical hardness is conservative for structural steels where the service stresses are lower than with high strength alloys: test results and practical experience indicate that SCC is unlikely in structural steels at below 450 VHN when exposed to marine conditions. (auth)

19211 MECHANISM INVOLVED IN THE ADSORPTION OF OXYGEN AT THE SURFACE OF SINGLE NIOBIUM CRYSTALS AT HIGH TEMPERATURES AND LOW PRESSURES. Simon, D.; Bardolle, J. (Orleans Univ., France). Compt. Rend., Ser. C; 278: No. 15, 1005-1008(8 Apr 1974). (In French).

The oxidation of single Nb crystals along (1,0,0), (1,1,0) and (1,1,1) planes has already been studied. It is postulated that the O_2 molecule at the surface of the metal constitutes an activated mobile complex having two compoaents of translational motion and a rotational motion. This reaction scheme is described and a more complete interpretation based on statistical thermodynamics is given. The agreement between the variations in activation entropy, ΔS, measured under the conditions of the reaction and those calculated using statistical thermodynamics was verified. (FR)

19212 ADSORPTION OF OXYGEN AT TUNGSTEN SINGLE CRYSTAL: THE (110) FACE. Ashcroft, K. W.; Leck, J. H.; Williams, E. M. (Univ. of Liverpool). J. Phys., C (London); 7: No. 11, 1965-1973(7 Jun 1974).

The interaction of oxygen gas with the (110) face of tungsten crystal was investigated by electron stimulated desorption and surface mass spectrometry. At 300°K, two states with desorption efficiencies of 6×10^{-7} and 5×10^{-6} ion/electron for production of O^+ ions are observed in the adsorption scheme. The former state forms rapidly on introducing gas to the clean surface and is essentially complete at an exposure of 0.3×10^{-6} L. The two states are identified with different temperature régimes of around 350 and 750°K for the removal of ion current and with total desorption cross sections of respectively 2×10^{-17} and 5×10^{-19} cm^2. Measurements of the energy distribution of desorbed ions reveal a difference of around 1.2 eV between the values of most probable ion energy from the two states. (auth)

19213 DISSOLUTION OF O_2 IN Nb BETWEEN 720 AND 1940°K BY REACTION WITH O_2 AND WATER VAPOR (10^{-7} TO 10^{-4} TORR). Jupille, J.; Michel, J. M.; Wach, J. (CNRS, Villers-les-Nancy, France). J. Chim. Phys.; 71: No. 2, 262-270(Feb 1974). (In French).

The solid-solution Nb–(O) obeys the Matthiessen's law: this result is used to determine the solubility limits, by progressive oxidation. From 1000 to 1940°K, the concentration limits C_L (at. %) correspond to the equilibrium (Nb) + [O] ⇌ ⟨NbO_y⟩, governed by the law: $LnC_L = (3.7 \pm 0.2) - (7600 \pm 200)/RT$ (1). From 720 to 1000°K, the concentration limits, such $LnC_L = -(0.15 \pm 0.40) + (1800 \pm 500)/RT$ (2) correspond to a sursaturated solution in presence of the suboxides NbO_y and NbO_z. This equilibrium is metastable from 810 to 1000°K. The stable configurations were obtained from 900 to 1000°K, where NbO_y and NbO_z are unstable,

and equilibrium (1) is found from 810 to 900°K, a slight sursaturation with respect to (1), which is perhaps due to NbO_x (stable until 900°K). (FR)

19214 INTRODUCTION OF ELECTROLYTE SUBSTANCE INTO ANODIC OXIDE FILMS ON NIOBIUM. Rokii, L. N.; D'yakonov, M. N.; Odynets, L. L. Elektrokhimiya; 8: No. 2, 289-291(1972). (In Russian).

A study was made of the introduction of H_3PO_4 anion into the oxide film formed anodically on Nb in aqueous solutions of the acid. It was established that during oxidation under galvanostatic, potentiostatic, and mixed conditions, the oxide film consists of two layers, with a P-free layer adjacent the metal and a layer enriched with uniformly distributed P. In galvanostatic conditions, the P concentration in the film increases with current. From an analysis of the P distribution profile in the film, it was found that acid anion mobility is 0.43 times that of oxygen ion. (auth)

19215 ANODIC ACTIVATION OF Nb AND Ta IN AQUEOUS SOLUTION OF KCl. Davydov, A. D.; Kashcheyev, V. D.; Kamkin, A. N. Elektrokhimiya; 8: No. 2, 282-284(1972). (In Russian).

A study was made of the anodic behavior of Nb and Ta in 1 to 4N KBr, and potentiodynamic curves were constructed at 3 V/min with a rotating disc electrode. The surface oxide film was destroyed and rapid metal dissolution commenced at a specific anode potential. The influence of solution concentration and agitation, also the addition of NaCl, was demonstrated. (auth)

19216 SATURATION OF THE SURFACE OF TITANIUM ALLOY VT6 WITH GASES. Tomsinskii, V. S. (Perm Polytechnical Inst., USSR). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 11-12, 1010-1012(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 11, 74-76(Nov 1973).

The effects of gas saturation on the Ti alloy VT6 (6.5% Al, 5.0% V, 0.19% Fe, 0.04% C, 0.02% N, 0.015% H, 0.06% Si) in air and vacuum at 750 to 1200°C for 5 to 360 min were studied. Samples were subjected to microstructural analysis, and the microhardness was measured along the cross section. It is concluded that gas saturation can be used to harden the surface, and that the depth and microhardness of the gas-saturated layer can be reduced by heating in vacuum. (DLC)

19217 CERTAIN FEATURES OF FORMATION OF THIN-LAYER POLYMER COATINGS ON BERYLLIUM BRONZE BELLOWS. Kharlamov, E. A.; Shchelkanov, V. G.; D'yakonov, V. A. Lakokrasoch. Mater. Ikh Primen.; No. 3, 40-41(1972). (In Russian).

Polyethylene and fluoroplast-3, applied electrostatically as powders during rotation and vibration of the workpiece, are shown to be suitable for anticorrosion protection. A device for imparting movement to the workpiece is described, and it is noted that the characteristics of the substrate material require special surface preparation. (Corros. Abstr.)

19218 APPLICATION OF THE X-RAY STRESS MEASUREMENT IN THE STUDY OF ZIRCONIA FILMS FORMED DURING HIGH-TEMPERATURE OXIDATION OF ZIRCONIUM AND ITS ALLOYS. Kraus, I.; Gosmanova, G. (Technical Univ., Prague). Jad. Energ.; 20: No. 5, 165-166(May 1974). (In Czech).

The x-ray method is described for measuring the growth stresses in ZrO_2 films appearing on Zr coating materials of fuel elements in an aggressive reactor medium. The method is based on measuring the changes of interplane distances normal to the surface of the sample where a centrally symmetric state of stress is assumed. The method was applied on ZrNb (1%) samples using monochromatic Cu K_α radiation with a diffractometer in Bragg-Brentano arrangement. The obtained values of compressive stresses $\sim 10^5$ psi are in agreement with macroscopic tensometric results. (auth)

19219 MECHANISM FOR CONTACT INTERACTION OF BORIDE COATINGS ON REFRACTORY METALS IN FRICTION AT TEMPERATURE INTERVALS FROM 20 TO 1500°C. Samsonov, G. V.; Sychev, V. V.; Tkachenko, Yu. G.; Koval'chenko, M. S.; Sosnovskii, L. A.; Yurchenko, D. Z. (Inst. of Problems in Materials Science, Kiev). Fiz.-Khim. Mekh. Mater.; 10: No. 3, 21-25(1974). (In Russian).

The temperature dependence of the friction coefficient of coatings of the diborides of Ti, Zr, Hf, V, Ta, Nb, and Cr and the monoborides of Mo and W on the corresponding metals was studied up to 1500°C. For the boride coatings, a minimum value of the coefficient of friction was observed at a temperature of $0.4T_f$. The data are discussed with consideration of the structure and electronic structure of the borides of the refractory metals. (tr-auth)

19220 TESTS OF ELEMENTARY MECHANISMS IN LIQUID SODIUM. Chouard, P. (CEN de Cadarache, Saint-Paul-les-Durance, France); Pomie, P.; Venobre, H.; Fontaine, J. P. Mecan. Mater. Elec.; No. 290, 7-15(Feb 1974). (In French).

For several years, the CEA and EDF have been studying friction in sodium environment processes. Particular emphasis is given to the application of the results acquired to various mechanisms under real operating conditions: heavily loaded bearings and screw/bolt studies (CEA Cadarache); bearing races and gear-wheel studies (EDF Renardieres Center). The experimental investigations are based on friction studies (seize-up tendency), corrosion studies, high temperature hardness measurements, and metallographic studies. The most typical results of tests carried out are examined. (FR)

Preparation and Fabrication

Refer also to abstracts 18247 and 18909.

19221 (GSI-tr-74/5) PREPARATION OF CYCLOTRON TARGETS FROM TRANSPLUTONIUM AND RARE EARTH ELEMENTS BY ELECTROLYTIC DEPOSITION FROM ISOBUTANOL. Korotkin, Y. S. (Gesellschaft fuer Schwerionenforschung m. b. H., Darmstadt (F. R. Germany)). Feb 1974. 20p. (In German). INIS.

11 figs.; 10 refs. With abstract. Published in the journal 'Radiokhimiya'. Translated from the Russian report JINR-P-6-7400. Available from ZAED.

The process of electrolytic deposition of transplutonium elements and rare earth elements from isobutanol was investigated, leading to the definition of process conditions allowing the preparation of cyclotron targets up to 2 mg/cm^2 which are resistant to irradiation with accelerated, multiply charged neon or oxygen ions. Small additions of ethanol (1 to 5%) will induce the formation of gas during the electrolytic deposition of the transplutonium and rare earth elements. (GE)

19222 (RFP-2174) CHEMICAL MILLING OF BERYLLIUM FOR MACHINING DAMAGE REMOVAL. Riegel, R. L.; Childs, E. L.; Souply, K. R. (Dow Chemical Co., Denver, Colo. (USA). Rocky Flats Div.). 8 Jul 1974. Contract AT(29-1)-1106. 16p. Dep. NTIS $4.00.

A chemical milling process for removal of machining damage from beryllium was developed and implemented. Details are given of a chemical milling solution prepared especially for ingot-source beryllium to meet surface finish specifications. The solution is used in the production of both ingot-source and powder-source beryllium parts. Close dimensional tolerances and improved uniformity were achieved by using temperature control and by rotary fixturing. A new concept for fixturing was developed which utilizes the buoyancy of beryllium parts in the milling solution to position and rotate the parts during the chemical milling operation. (auth)

19223 STUDY ON THE REDUCTION OF TUNGSTEN POWDER FROM DOMESTIC APT. I. On the Reducibility of WO_3 of the Reduced Tungsten Powder. Park, W. K.; Eun, K. Y. J. Korean Inst. Metals; 11: No. 3, 263-269(1973).

In the reduction process of metallic tungsten powder from domestic APT, the thermal decomposition of APT and the reducibility of WO_3 were investigated. APT was completely decomposed to angular plane-shaped skeleton particles of WO_3 at 450°C in 30 minutes, which were easily crushed to primary fine particles. When 6 gr of WO_3 was packed into nickel boat 6 mm in thickness with high packing density of 1.25 g/cc, it was completely reduced to metallic tungsten at 800°C with hydrogen flow rate of 1000 cc/min in 40 minutes and also at 900°C with hydrogen flow rate of 1500 cc/min in 20 minutes. It is expected that in industrial process WO_3, which has lower packing density, will be reduced to metallic tungsten with lower hydrogen flow rate and shorter reduction time than those limited conditions. Reducibility was retarded with decrease of reduction temperature and hydrogen flow rate and with increase of sample thickness and water content of hydrogen. (Korean Sci. Abstr.)

19224 BOROTITANIZING OF IRON. Zemskov, G. V.; Kogan, R. L.; Shevchenko, I. M.; Viderman, V. S. Zashch. Pokrytiya Metal.; No. 6, 117-119(1972). (In Russian).

Microstructural and X-ray diffraction analyses of the surface layers created by the borotitanizing of Fe during successive saturations with B and Ti are presented. The nature of the processes taking place when Ti and B atoms contact one another in the Fe lattice is discussed. On subjecting already-borided Fe to diffusion saturation with Ti, a zone having a microhardness up to 3180 kg/mm^2 is created; it contains TiB_2 and a certain amount of $FeTi_2$. The intermetallic phases so formed ensure a thickness of the hardened zone up to 30 μm. When Ti diffuses into borided Fe at high temperatures, some of the B atoms are removed from the Fe and combine with the Ti. (Metals Abstr.)

19225 SATURATION OF NIOBIUM WITH TITANIUM, CHROMIUM, AND SILICON FROM THE SUBLIMED PHASE IN VACUUM. Ponomarenko, E. P.; Petrovskaya, L. M. Zashch. Pokrytiya Metal.; No. 6, 129-133(1972). (In Russian).

The diffusion processes taking place during the saturation of Nb and Nb alloys with Ti, Cr, and Si from the sublimed phase in vacuum at 1200 to 1400°C for periods of 4 to 12 h were studied. Their diffusion into the Nb or Nb alloys took place via condensed films of the diffusing element, the thicknesses of the films amounting to as much as 10 μm at the end of the diffusion process. The diffusion coefficient and activation energies of the diffusing elements accordingly assumed unusual values (as a result of the complexity of the saturation process). The diffusion of Cr and Si was furthermore of a reactive character. These factors had to be considered when saturating with two or more elements simultaneously. (Metals Abstr.)

19226 KINETICS OF THE DEPOSITION OF NIOBIUM AND NIOBIUM STANNIDE FROM THE GAS PHASE. Ugol'nikova, T. A.; Moiseev, A. I. Zashch. Pokrytiya Metal.; No. 5, 145-149(1971). (In Russian).

A method of producing deposits of Nb and the superconducting compound Nb_3Sn from the gas phase is described. Deposition is effected by H reduction of the chlorides ($NbCl_5$ and $SnCl_4$) on a heated Pt or W wire; high-quality Nb or Nb_3Sn deposits are the result. The amounts deposited are sensitive to the temperature of the heated wire, the composition of the vapor-gas mixture, and the rate of H flow. An analysis of the experimental relationships shows that the limiting rate of growth of the deposit for a given substrate temperature is set by the rate at which the elementary processes taking place on the surface of deposition proceed. The rate of deposition falls when the rate of access of H or vapor to the surface diminishes. (Metals Abstr.)

19227 AGING OF NIOBIUM ALLOYS OF THE Nb-1Zr-C SYSTEM UNDER ELECTRON BEAM WELDING CONDITION. Aref'ev, Yu. V.; Chernyshova, T. A. Svar. Proizv.; No. 10, 7-10(Oct 1973). (In Russian).

The effect of the welding regime on the properties of the welded compounds and the kinetics of aging of Nb alloys of the Nb-1Zr-C system was studied. In the welded seams of alloys of this system with C contents of 0.01 to 0.03% and higher, destruction of the supersaturated solid solutions occur immediately in the cooling process during welding. The destruction occurs at the same intensity as in longer resident times of the metals in the temperature interval from 800 to 1000°C. Alloys of this system with C concentrations less than 0.02% are not sensitive to the parameters of thermal cycling in the welding. (tr-auth)

19228 ELECTRON BEAM WELDING OF NIOBIUM ALLOY WITH STAINLESS STEEL THROUGH VANADIUM INTERLAYER. Veinik, V. A.; D'yachenko, V. V.; Chukanov, A. P. Svar. Proizv.; No. 5, 16-18(May 1973). (In Russian).

Results of the experimental investigation of the electron beam welding of the Nb alloy VN-2-AE with the stainless steel KH18N10T through a V interlayer were reported. It was shown that the selection of the barrier element during the welding of heterogeneous metals can cause, on the basis of graphs, mutual solubility of the elements in the solid state. (tr-auth)

19229 BUTT WELDING OF IMMOVABLE PARTS OF PIPELINES OF NIOBIUM BASE ALLOYS. Bol'shakov, M. V. Avtomat. Svarka; No. 7, 51-52(1973). (In Russian).

The technology of the automatic welding of pipes in a controlled atmosphere of inert gases is described. The properties of the joints at high temperatures are reported. It was established that the change of the welding rate from 10 to 60 m/h essentially does not affect the properties of the joints. The dependence of the strength of the pipe joints from Nb alloy on temperature and the microstructure of the joint of the VN-2AE alloy welded in argon was shown. (tr-auth)

19230 CATHODIC PROCESS IN THE ELECTRODEPOSITION OF CHROMIUM-MOLYBDENUM ALLOY. Shluger, M. A.; Shirokova, N. V. (Moscow Metallurgical Evening Inst.). Prot. Metals (USSR) (Engl. Transl.); 9: No. 1, 100-102(1973).

Translated from Zashch. Metal.; 9: No. 1, 105-108(1973).

Results of the investigation show that potentiodynamic polarization curves are displaced towards positive potentials with the addition of molybdic acid to the chromium plating electrolyte is due to processes involving incomplete reduction of hexavalent molybdenum. The possibility of the reduction of molybdate ion to form intermediate products was verified by investigating a freshly prepared solution and a solution after prolonged electrolysis at a current density of 5 A/dm^2 on a Unicam SP800 spectrophotometer. The electrolyzed solution gave absorption maxima in the region of 420 and 465 mμ, which correspond to the absorption bands of certain forms of pentavalent molybdenum and show that incomplete reduction of hexavalent molybdenum occurs within the limits of the first branch on the polarization curve for the chromium plating electrolyte containing molybdic acid. (JRD)

19231 STUDY OF COATINGS IN THE NICKEL-CHROMIUM-BORON SYSTEM DEPOSITED BY PLASMA SPRAYING. Veksler, Yu. G.; Kupriyanov, I. L.; Osinovskii, V. A. Zashch. Pokrytiya Metal.; No. 5, 192-194(1971). (In Russian).

The development of a plasma spraying technique with subsequent diffusion annealing to create protective Ni-Cr-B layers on steels and alloys is described. Special attention is given to the determination of those conditions necessary to obtain the best adhesion to the base combined with the maximum possible degree of wear resistance. Tests both at room temperature and in a special high-temperature (>900°C) testing machine indicate the considerable advantages possessed by the new technique over the conventional electrodeposition of Cr. Examples are given for tests carried out over 300 h at 800 to 900°C, and the distribution of the alloying elements over the diffusion coatings is illustrated. (Metals Abstr.)

19232 X-RAY DIFFRACTION STUDY OF MOLYBDENUM AND AND TUNGSTEN INTERACTION WITH DISPERSE INCLUSIONS. Strashinskaya, L. V.; Stashevskaya, I. A. (Inst. of Problems in Materials Science, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 5, 93-95(May 1974). (In Russian).

Molybdenum and tungsten interaction with the precipitation strengthening additives ZrC, HfC, TaC, ZrN, ZrO_2, CaO, La_2O_3, and Nd_2O_3 was investigated. It was established that when using ZrC, HfC, TaC, and ZrN as strengthening additives, the period of the metal-base lattice increased gradually with a rise in the samples heating temperature; when an oxide (ZrO_2, CaO, La_2O_3, Nd_2O_3) served as an additive, the value of the period of the W and Mo lattice did not change in this case; during heating of Mo with the ZrN additive the formation of a new phase, Mo_2N, was observed. (auth)

19233 SOLID-PHASE SINTERING OF $SmCo_5$. Jorgensen, P. J. (Stanford Research Inst., Menlo Park, CA); Bartlett, R. W. J. Less-Common Metals; 37: 205-212(1974).

The sintering kinetics of $SmCo_5$ were investigated as functions of stoichiometry, time, and temperature. The shrinkage or densification kinetics are not affected by changes in stoichiometry; therefore no correlation exists between densification kinetics and subsequent magnetic properties. The data indicate that more than one atomic transport process is operative during the sintering process. Because of this complication, the sintering mechanisms can be only tentatively identified without an assessment of their individual magnitudes. It is speculated that the atomic transport processes responsible for sintering of $SmCo_5$ are grain-boundary diffusion and surface diffusion. (6 fig) (auth)

19234 RELATIONSHIP BETWEEN COMPOSITION OF ELECTRODEPOSITED NICKEL-MOLYBDENUM ALLOYS AND PLATING FACTORS. Higashi, K.; Fukushima, H. Kinzoku Hyomen Gijutsu; 24: No. 9, 486-490(Sep 1973). (In Japanese).

The composition of electrodeposited Ni-Mo alloys was investigated in relation to bath composition and temperature, and current density. The Mo content of the deposit increases with Mo and total metal ion content in the bath, and temperature; it decreases with increase of pH and current density. The composition of the deposit is unaffected by the concentration of potassium sodium tartrate in the solution. The current efficiency decreases with increase in Mo content of the deposit. (Metals Abstr.)

19235 EFFECT OF DEOXIDATION BY CERIUM AND MISCHMETAL ON THE COMPOSITION AND TYPE OF SULPHIDE INCLUSIONS IN STEEL FOR CASTINGS. Schindlerova, V.; Buzek, Z. Slevarenstvi; 20: No. 12, 492-495(Dec 1972). (In Czech).

The dependence of the formation of the type I inclusions on Ce content was studied for steel containing Ce, 0.4, Mn 1% and containing only type III inclusions initially. Steel was deoxidized initially using Mn, Si, and 1 kg/t Al to form type III inclusions. Ce was added in the amount 0 to 5 kg/t into the ladle. Notch toughness of the steel was measured, inclusions were subjected to x-ray microanalysis. The results of the microanalysis are shown, Ce sulfides, oxides, and mixed sulfides were found. Optimum type I inclusions are produced at 1 to 2 kg Ce/t. The residual content of Ce is decisive and not Ce addition for the formation of type I inclusions. At higher Ce concentrations (5 kg Ce/t) harmful inclusions of the type IV are formed. (Metals Abstr.)

19236 ELECTROLYTES FOR THE ELECTROCHEMICAL MACHINING OF NIOBIUM. Davydov, A. D.; Kamkin, A. N.; Klopova, S. V.; Kashckeev, V. D. Elektron. Obrab. Mater.; No. 6, 28-30(1973). (In Russian).

The relative merits of various electrolytes for the electrochemical machining of Nb are considered. For the accurate electrochemical dimensional machining of this metal, or alloys containing a high proportion of Nb, it is essential to use solutions with a fairly high concentration of Br^- anions. An example is given for the machining of Nb and Nb alloys in an electrolyte based on KBr

together with small amounts of NaOH and $NaNO_3$. The optimum electrical parameters are indicated in relation to the composition of the solution and the nature of the machining operation to be carried out. (Metals Abstr.)

19237 PRESSURELESS PROCESS FOR MANUFACTURE OF P/M PREFORMS. DiGiambattista, V. N.; Reilly, W. E. (American Powder Casting Co., Ann Arbor, MI). pp 153-173 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P7.

A patented powder metallurgy process is described which is used to reconsolidate Ni, Co, and Cr base metal powder alloys to 99% of theoretical density without high temperature and high pressure equipment. The process is predicated on removal of all surface oxides and gas molecules which may be adsorbed by individual powder particles followed by thermal activation of particle surfaces so that ionic and/or interatomic exchange occurs between the particles in intimate contact. (JRD)

19238 EUTECTIC BONDING OF BORON-ALUMINUM STRUCTURAL COMPONENTS. II. Development and Application of the Process. Niemann, J. T.; Garrett, R. A. (McDonnell Douglas Astronautics Co., East St. Louis, IL). Weld. J. (N. Y.); 53: No. 8, 351s-360s(Aug 1974).

From 54th AWS annual meeting; Chicago, IL (2 Apr 1973).

This was part of programs to develop a low-pressure technique for fabricating B-Al structural components and to evaluate B-Al components for space shuttles. The evaluation of critical processing parameters was reported previously; this part describes the development of production processes and their application to component fabrication. For the chemical cleaning of monolayer foil, candidate cleaning processes were evaluated using ellipsometry to measure residual aluminum oxide layer thickness; a technique was selected for good cleaning with reprocessing flexibility. The effects of monolayer storage conditions (both the uncoated and copper-coated monolayer) on the rate and buildup of oxide layers were measured by ellipsometry. A nitrogen environment was satisfactory with permissible storage times of 80 h for the cleaned monolayer prior to vapor deposition and 800 h after copper coating. The techniques necessary to produce an adherent physical vapor deposition (PVD) copper layer on the monolayer were developed; the ability to apply a 20 micro in. coating was demonstrated. Further, parameters for glow discharge cleaning prior to PVD were evaluated through ellipsometer studies. Finally, complex B-Al structures were fabricated with structural shapes utilizing a mechanical forming technique to simultaneously pressure-form all monolayers prior to bonding. These structures demonstrated strengths in excess of design ultimate loads at 600°F. An integrally stiffened B-Al panel was fabricated, utilizing a simple, re-usable tooling concept which can be cost competitive with titanium machinings. (19 figures) (auth)

19239 HOT ISOSTATIC COMPACTION IS KEY TO QUALITY TITANIUM PARTS. Gurganus, T. B.; Turnbull, G. K. (Aluminum Co. of America, Merwin, PA). Metal Progr.; 106: No. 3, 83-84; 86; 88(Aug 1974).

A number of approaches were tried, including cold compact and sinter, compact-sinter-forge, and extrusion. Hot isostatic compaction proved to be the only way to obtain the required microstructural control. The material used was Ti-6Al-4V. (DLC)

19240 WELDABILITY OF TSM-4 MOLYBDENUM ALLOY. Alekseenko, G. N. (Inst. of Electrical Engineering, Kiev); Gurevich, S. M.; Nerodenko, M. M.; Biryukova, T. A.; Chernyavskii, K. S.; Shchukin, A. A. Avtomat. Svarka; No. 5, 45-48 (May 1973). (In Russian).

The properties and structure of welded joints of Mo alloys (TSM-4) were studied. The properties of the basic alloy and of the welded joints are presented as a function of the temperature and rate of welding. Annealing of welded joints subjected to thermal processing did not increase the plasticity of the seam metal. Annealing before welding improved the plasticity and decreased the temperature of cold brittleness of the joint. Preliminary annealing of the metal at 1300-1500°C for 1 h gave best results. (tr-auth)

19241 DIE STEELS FOR HIGH-SPEED AUTOMATIC HOT DIE FORGING MACHINES. Rauzina, E. Ya.; Zabezhinskii, A. Ya.; Shein, A. S. (All-Union Scientific-Research Inst. of the Bearing Industry, Moscow). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 11-12, 944-949(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 11, 20-25(Nov 1973).

A comparative study was made of die steels: 3Kh2V8F, 4Kh2V5FM, steels of the 4Kh4M2VFS type, steels containing 3 to 5% Cr, a steel containing 3% Co, and steels subjected to electroslag (ESR) and electron beam remelting. Up to 8.5% W, 1% V, and 3% Mo were present in some of the steels. Mechanical properties were measured; results show that 3Kh3M3F produced by ESR had the best combination of strength, hardness, toughness, and resistance to crazing. (DLC)

19242 EFFECT OF THE THERMAL CYCLE IN WELDING ON THE STRUCTURE AND PHASE COMPOSITION OF THE HEAT-AFFECTED ZONE IN MARAGING STEEL. Shorshorov, M. Kh.; Antipov, V. I.; Kudinov, E. D.; Mikhaleva, E. I. (Inst. of Metallurgy, Moscow). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 11-12, 991-992(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 11, 62-63(Nov 1973).

The maraging steels are of the 18 Ni-8 Co-3 Mo-Ti and 14 Ni-4 Cr-3 Mo-Ti types. The increase of grain size during welding depends on the cooling rate and on the time the metal remains at temperatures above the $\alpha \rightarrow \gamma$ transformation temperature. Cooling from $\alpha \rightarrow \gamma$ transformation temperatures at a low rate leads to an increase in the amount of retained austenite and some reduction of hardness in the heat-affected zone. (auth)

19243 WEAR RESISTANCE OF DIE STEELS IN BLANKING. Geller, Yu. A.; Aranovich, A. O.; Moiseev, V. F.; Fedosienko, S. S.; Bronin, S. V. (Moscow Machine-Tool Inst.). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 11-12, 955-958(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 11, 30-34(Nov 1973).

The wear resistance of steels for cold work dies increases with the amount of carbide phase up to ~25% (the limit at which the malleability of the steel is retained). The carbide phase should consist of M_7C_3 and VC carbides. Steel Kh12F4 and high-vanadium steels Kh3F12, Kh3F8, and KhG2F8 have the best wear resistance. However, steel Kh12F4 has a better combination of mechanical and technological properties (is ground more easily) and is recommended for manufacturing elements of blanking dies. Steels with a high vanadium content are recommended primarily for dies of simple shape that are not ground. The heat treatment for steel Kh12F4M is quenching in oil from 1070-1090° and tempering at 170-190° to HCR 62-63 (for dies of simple shape) or at 200-230° to HRC 59-60 (for dies of complex shape). It is not expedient to use graphitized steel for cold blanking dies. (auth)

19244 EFFECT OF TITANIUM ON THE GROWTH OF BORIDE COATINGS. Permyakov, V. G.; Trush, I. Kh.; Loskutov, V. F.; Pisarenko, V. N.; Yakovchuk, Yu. E. (Kiev Polytechnical Inst.). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 11-12, 1005-1006(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 11, 71-72(Nov 1973).

The purpose was to determine the effect of Ti on the growth and properties of the boride coating on Fe-Ti alloys in commercial boron carbide and on grain growth in the transition zone. Raising the titanium content of the alloy reduces the depth of the boride case. Titanium dissolves in FeB, which leads to an increase of the hardness. It is expedient to 0.5-0.6% Ti—to steels subjected to boriding. (auth)

19245 PREPARATION OF THIN FOILS OF ZIRCONIUM AND ZIRCONIUM ALLOYS FOR ELECTRON MICROSCOPY. Northwood, D. O.; Gilbert, R. W. (Chalk River Nuclear Labs., Ont.). J. Aust. Inst. Metals; 18: No. 3, 158-160(Sep 1973).

A technique is described which has been used with Zr and Zr-rich alloys both before and after neutron irradiation, with sintered Zr-alloys containing Y_2O_3 dispersions, and with Inconel-X750 and 403 stainless steel. Specimens are pre-thinned to suitable size and the resultant disks are jet electropolished to electron transparency. Hydrides formed are distinguished from neutron damage by "black spot" size and oxides are distinguished from neutron damage by focussing which gives contrast changes when there are no strain fields. (AT)

19246 SURFACE HARDENED Ti OR Zr AND THEIR ALLOYS AND METHOD OF PRODUCING THE SAME. Ohtani, S.; Nishigaki, M. (to Kabushikikaisha Kobe Seikosho). British Patent 1,346,322. 6 Feb 1974. Filed date 11 Mar 1971. 7p.

Although Ti and Zr show superior corrosion resistance in comparison with other metals, they have low hardness and if in frictional contact with other metals seizure tends to occur. It has been proposed to harden the surface by nitriding, but since the surface-hardened layer thereby obtained is very thin its endurance is very short. The treatment process is also complicated. In the process described the Ti or Zr, or alloys thereof, is given a coating of a metastable-phase Ti-base or Zr-base alloy aged to precipitate the alpha or the omega phase. The metastable beta alloy is aged to have a Vickers hardness above 400, and suitable alloys are listed. Ageing is conducted at 200 to 500°C, and the surface-hardened layer may be formed to any desired thickness.

Means for coating the metastable beta phase on to the surface of the metal to be treated may be diffusion welding or explosive pressure welding, but the most effective and simplest method is deposit welding; this gives no possibility of formation of a fragile welded portion due to metallurgical reactions. The ageing period is normally in the range of 5 min to 20 h. (UK)

19247 RESIDUAL STRESSES AND FABRICATION TECHNOLOGY OF COLD-DRAWN WIRE OF HEAT-RESISTANT ALLOYS. Leshchiner, A. M.; Zhuchin, V. N.; Varle, K. V.; Dzugutov, M. Ya.; Korneev, N. I.; Fomicheva, E. I.; Malygina, V. I. Stal; No. 8, 769-771(Aug 1973). (In Russian).

The principles of the formation of deep surface discontinuous cracks observed in wires of heat-resistant elastic alloys based on Ni–Cr (for example, EP578 type), Ni–Cr–Fe, and Ni–Mo were studied. It was established that this defect is shown by the presence of stretching residual stress in the surface layers of cold-drawn wires which remain heated up to 500 to 550°C. A drawing regime reducing the residual stress to a minimum is recommended. The rolling of cold-drawn wires by rollers through its recrystallization annealing converts the stretching residual stress at the surface to compression stress and completely eliminates splitting. (tr-auth)

19248 DEPENDENCE OF THE COMPOSITION OF ELECTROLYTIC Co–Re ALLOYS ON THE ELECTROLYSIS CONDITIONS. Terent'eva, N. I.; Yur'ev, B. P. J. Appl. Chem. USSR (Engl. Transl.); 47: No. 1, 210-211(Jan 1974).

Translated from Zh. Prikl. Khim.; 47: No. 1, 213-214(Jan 1974).

Experiments were made on electrolytic Co–Re alloys obtained from sulfate–perrhenate solutions to determine if there are breaks on the plots of the alloy composition corresponding to breaks on the polarization curves. The total and partial polarization curves for joint reduction of Co, Re, and H from sulfate–perrhenate solutions at pH = 7.0 and 70° have a break at $\varphi = -0.6$ V. An analogous break can be seen on the plot of log $([Co]/[Re]_{in}^{gr}$ against the logarithm of the cathodic current density. The dependence of the composition of the Co–Re alloys and current efficiency for alloy deposition on the ratio [Co]/[Re] of the ionic concentrations in solution at a constant total content of these metals is shown. The Co content in the alloy increases with the relative concentration in solution, but the two quantities are not directly proportional. The current efficiency for Co–Re passes through a maximum with increase of current density and relative Co concentration in solution. Variation of total concentration of Co and Re at constant ratio of the metals in solution has relatively little influence on the alloy composition. (JSR)

19249 PROPERTIES OF HEAT-AFFECTED ZONES IN FERRITIC STEELS WITH 2.25% Cr AND 1% Mo EITHER STABILIZED OR NOT STABILIZED WITH Nb AND V. Donati, J. R.; Valibus, L.; Zacharie, G. (Electricite de France, Ecuelles). Mem. Sci. Rev. Met.; 71: No. 3, 187-194(Mar 1974). (In French).

From autumn meeting on metallurgy; Chatenay-Malabry, France (2 Oct 1974).

The influence of the stabilizing elements on the weldability of the steels was studied. The tests, carried out on plates, are described: examination of the embrittlement of the heat-affected zone before and after a stress-relieving treatment; study of the hot-cracking in the neighborhood of the weld line, a tensile test being carried out on a RPI machine. (FR)

19250 ULTRAFINE TUNGSTEN AND MOLYBDENUM POWDERS. Savin, A. V.; Panfilov, S. A.; Chizhikov, D. M.; Tsvetkov, Yu. V. Fiz. Khim. Obrab. Mater.; No. 2, 141-145(1974). (In Russian).

The conditions for the refining, compression, and sintering of ultrafine W and Mo powders with particle sizes from 0.1 to 0.01 μ were studied. As a result of the refining during annealing in hydrogen at 800 to 1100°C the specific surface of the ultrafine powders was reduced and their compressibility was improved. Annealing up to 1100°C does not significantly reduce the activity of the ultrafine W powder. W close to the theoretical density at sintering temperature of 1500°C was obtained from the annealed powder. An explanation was given for the observed differences in the capacity for deoxidizing the ultrafine W and Mo powders as a function of the annealing regime of the powders and their sintering. (tr-auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 19142, 19774, 20362, and 20367.

19251 (AE-488) CRITICAL ANALYSIS OF THE RING EXPANSION TEST ON ZIRCALOY CLADDING TUBES. Pettersson, K. (Aktiebolaget Atomenergi, Studsvik (Sweden)). May 1974. 8p. Dep. NTIS (US Sales Only) $4.00.

The deformation of Zircaloy tubes under different testing procedures is analyzed with regard to the mechanical anisotropy of the material. It is concluded that the ring expansion test is in most cases unsuitable for the determination of the ductility of the cladding. The basic arguments also apply to other uniaxial tension testing methods. (auth)

19252 (AED-Conf-73-658-001) CONSIDERATION OF PULSATING STRESSES IN THE DESIGN OF PRESSURE CONDUCTION COMPONENTS. Schaar, K. (Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e. V.; Essen (F. R. Germany)). 1973. 9p. (In German). INIS.

From 13th congress and exhibition on labour protection and industrial medicine; Duesseldorf, F. R. Germany (3 Oct 1973).

8 figs.; 1 ref. Available from ZAED.

The paper describes the parameters which influence the lifetime of pressure conducting devices such as reactor pressure vessels and other cylindrical tanks. Especially considered are crack growth phenomena in the presence of pulsating loads, which derange the material by changing plastic deformations. (GE)

19253 (AED-Conf-74-089-013) VACANCY MIGRATION IN b. c. c. TRANSITION METALS. Schultz, H. (Max-Planck-Institut fuer Metallforschung, Stuttgart (F. R. Germany). Inst. fuer Physik). 1974. 6p. INIS.

From spring meeting of the Working Group Solid State Physics of the Deutsche Physikalische Gesellschaft e.V.; Freudenstadt, F. R. Germany (1 Apr 1974).

3 tabs.; 34 refs. Available from ZAED.

Trends predicted theoretically for vacancy migration in bcc metals are reported. Vacancy migration in the group V transition metals, V, Nb, Ta, and in α-Fe is suggested to occur at relatively low equivalent temperatures, and the values of H_V^m, the activation enthalpy of migration, to be low in contrast to group VI transition metals Cr, Mo, and W. New experimental findings apparently supporting the predictions are given. (GE)

19254 (COO-3150-24) TILTED FIELD RADIO-FREQUENCY SIZE-EFFECT IN TUNGSTEN. Baer, D. R. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Atomic and Solid State Physics). Jun 1974. 43p. Dep. NTIS $5.25.

The radio-frequency size-effect (RFSE) signals in a magnetic field inclined at an angle to the sample surface were studied in tungsten plates using a transmission method. A parameterized model of the tungsten Fermi surface and the geometric model of the RFSE were combined to allow a calculation of expected signal positions and these results are compared to the experimental data. There is excellent agreement between the model calculations and the data. The use of these RFSE signals to measure the temperature dependent mean-free path is discussed, as well as the relation of the tilted field RFSE signals to Gantmakher–Kaner oscillations. (10 fig) (auth)

19255 (COO-3415-3) TRANSFORMATIONS IN AB_2 INTERMETALLIC COMPOUNDS. Final Report, January 1, 1963–June 14, 1972. Ryba, E. (Pennsylvania State Univ., University Park (USA)). 1974. Contract AT(11-1)-3415. 56p. Dep. NTIS $6.00.

Crystal structures, crystal chemistry, thermal expansion, and magnetic and mechanical properties of intermetallic compounds which exhibit the KHg_2-type structure were studied. Structural data are presented for a number of $REZn_2$ compounds which are very similar to those for other KHg_2-type compounds. From these, it appears that, while the overall configuration is a result of directional bonding, there is sufficient isotropy in the bonding to allow for atom shifts in the various compounds. The atom positions can be reasonably predicted on the basis of hard sphere packing. The coordination number of the A atoms was found to be 16. The KHg_2-type structure is closely related to the AlB_2-, $CaIn_2$-, and the CdI_2-type structures in that all contain hexagonal B-atom nets in some form. The thermal expansion of $HoZn_2$ and $YbZn_2$ and were studied and qualitatively interpreted in terms of the structural configuration of the atoms. In the case of $YbZn_2$, crystallographic evidence for a phase change over the range 300-600°C was found. It appears that the high temperature phase is isostructural with $NdAu_2$, whose structure is yet unknown, although closely related to the $MoSi_2$-type structure. This structure change may be related to a valence change. Magnetic susceptibility measurements of $REZn_2$ compounds showed that the rare earth atoms exhibit a +3 valence, except in $CeZn_2$, $EuZn_2$, and $YbZn_2$, where +3 and +2 valences are mixed and temperature dependent. Mechanical property data are presented for $HoZn_2$. It is a typical brittle material which exhibits a small amount of plastic deformation by twinning. Crystal structure data are presented for the following related compounds: YbCuZn, YZn_3, $DyZn_3$, $HoZn_3$, $ErZn_3$, Y_3Zn_{11}, $Y_2Zn_{\sim 9}$, $Er_2Zn_{\sim 9}$, YZn_6, and $ErZn_{6-7}$. (18 fig, 6 tables, 55 references) (auth)

19256 (LA-5442-MS) U–0.83 wt % Ti ALLOY: COOLING RATES OF GAMMA-QUENCHED ALLOY, RESULTING MICROSTRUCTURE AND RESPONSE TO AGING. Javorsky, C. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Mar 1974. Contract W-7405-eng-36. 13p. Dep. NTIS $4.00.

Samples from a U–0.83 wt % Ti alloy were subjected to various cooling rates, and response to subsequent aging was investigated. By a suitable choice of quenching media, cooling rates were varied from 3.9 to 190°C/s. Resulting as-quenched microstructures and hardnesses were not a function of cooling rates when rates were greater than 40°C/s. Aging treatments were monitored by metallographic observations and hardness measurements, and cooling rates greater than 40°C/s produced no relative changes in aging response. Tensile properties of selected quenched and aged specimens are the basis for conclusion that strength and ductility are unaffected by cooling rate. (auth)

19257 (NRL-7710) INFLUENCE OF CALIBRATION PROCEDURE UPON DETERMINATION OF J_{Ic} FOR A TITANIUM 6Al-4V ALLOY. Yoder, G. R.; Griffis, C. A. (Naval Research Lab., Washington, D.C. (USA)). 30 Apr 1974. 26p.

The influence of calibration procedure on the determination of J_{Ic} from fatigue-precracked elastic-plastic specimens of a Ti–6Al–4V alloy was examined. Results are compared from five compliance-type calibrations, each derived from sets of load vs load-point-displacement diagrams which differ in origin. These sets include diagrams obtained from notched specimens of two different thicknesses, diagrams generated analytically from the plane-stress and plane-strain solutions of Bucci et al. as corrected for machine contribution to displacement, and from the uncorrected plane-stress solution which simulates well the load vs load-point-displacement behavior of the fatigue-precracked specimens. The J_{Ic} results obtained from these five calibrations are in substantial agreement with each other and with a known value of K_{Ic} for this material. Preliminary results from application of the deep-slot bend approximation are in accord with those determined from the compliance-type calibration procedures. (10 figures) (auth)

19258 (UCLA-34-P-177-21) REACTOR STEELS STUDIES. Quarterly Progress Report, October–December 1973. Ono, K.; Tetelman, A. S.; Ardell, A. J. (California Univ., Los Angeles (USA). Dept. of Materials). Jun 1974. Contract AT(04-3)-34. 11p. Dep. NTIS $4.00.

The steady-state creep rate of 2¼ Cr–1 Mo steel was extrapolated from data at 850 and 1050°F. Preliminary data are given for the effects of cold work on the creep–rupture properties of Type 316 stainless steel at 1400°F and 25 Ksi stress. (DLC)

19259 (WARD-HT-3045-5) VALIDATION OF HIGH TEMPERATURE DESIGN METHODS AND CRITERIA. Quarterly Progress Report for Period Ending February 28, 1974. Bishop, E. C. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). May 1974. Contract A(11-1)-3045. 144p. AT.

Activities in a program to test and analyze specimens of Types 304 and 316 stainless steel in a broad range of configurations under complex stresses are summarized. Information and data are presented on basic specimen testing, tubular specimen testing, structure testing, FFTF nozzle testing, code validation, and elevated temperature design standard. (JRD)

19260 EFFECT OF PRESSURE ON THE ELECTRON TRANSPORT PROPERTIES OF LIQUID ALKALI METALS. Oshima, R. (Kyoto Univ.); Endo, H.; Shimomura, O.; Minomura, S. J. Phys. Soc. Jap.; 36: No. 4, 730-738(Mar 1974).

The pressure effect on the resistivity and the thermopower of liquid alkali metals (Cs, Rb, K, Cs–Na alloys, and Cs–K alloys) was studied up to around 30 kbar. It was found that the pressure gives a considerable effect on the transport properties of liquid Cs, Rb, and their alloys. The thermopower of liquid Cs changes remarkably with pressure. It exhibits the maximum at pressure of 16 kbar and then decreases with increasing pressure. The importance of d-band in heavy alkali metals is discussed. (auth)

19261 HIGH CHROMIUM CONTENT FERRITIC STEELS WITH MOLYBDENUM. Colombie, M.; Condylis, A.; Desestret, A.; Mayoud, R.; Grand, R. (Societe Creusot-Loire, Unieux, France). Mater. Tech.; No. 3, 157-172(Mar 1974). (In French).

From meeting on molybdenum in steels; Paris, France (29 Nov 1973).

Ferritic Fe–Cr and Fe–Cr–Mo alloys having Cr contents of greater than 20% and low carbon contents form an important group of stainless steels. The following topics are covered: industrial fabrication (high frequency vacuum furnace, electron bombardment furnace); mechanical properties (ductility); corrosion resistance (intergranular corrosion, injection and crack corrosion, stress corrosion); welding; utilization (chemical industry, paper industry, petrochemical industry, food industry, desalination of sea water, thermal and nuclear plants). (FR)

19262 OXYGEN DIFFUSION IN ZIRCONIUM AT 1100°C. Dechamps, M. (CNRS, Vitry-sur-Seine, France); Lehr, P.; Cochnar, Z. Compt. Rend., Ser. C; 278-8: No. 8, 483-486 (18 Feb 1974). (In French).

Zirconium samples were thermally oxidized at 100°C in pure oxygen. They were subsequently diffusion annealed under vacuum at the same temperature. The growth and/or decay kinetics of the different phases are presented. In this way, the oxygen diffusion coefficients at 1100 were determined for the α and β phases: $D_\alpha = 2.83 \times 10^{-9} cm^2 \cdot s^{-1}$; $D_\beta = 1.75 \times 10^{-6} cm^2 \cdot s^{-1}$. (FR)

19263 STUDY OF THE WEAR RESISTANCE OF VARIOUS DIFFUSION COATINGS INCORPORATING BORON. Golego, N. L.; Golego, N. N.; Labunets, V. F. Zashch. Pokrytiya Metal.; No. 6, 176-179(1972). (In Russian).

The wear resistance of C and alloy steel parts provided with various diffusion coatings incorporating B was studied under conditions of normal friction, slipping, and fretting corrosion. Results were compared with those characterizing the untreated metal. The methods employed were boriding in powders, borosilicizing by electrolysis from melts, and the creation of finely-dispersed boride structures (FeB, Fe_2B) on the surface by a combined technique. Although the results differed in detail, in every case the incorporation of B greatly increased the life of the treated machine parts, typically by a factor of 10. (Metals Abstr.)

19264 ELASTIC CONSTANTS OF GADOLINIUM, TERBIUM, AND ERBIUM. Palmer, S. B. (Hull Univ., Eng.); Lee, E. W.; Islam, M. N. Proc. Roy. Soc. (London), Ser. A; 338: No. 1614, 341-357(28 Jun 1974).

The five single-crystal elastic constants of Gd, Tb, and Er were measured within the temperature range 4.2 to 300°K. Contributions to the elastic constants due to domain and spin rotation effects were reduced and in some cases eliminated altogether by applying a magnetic field of 2.5 T along the magnetic easy directions. (auth)

19265 COMPLEX SURFACE SATURATION OF THE [NICKEL–CHROMIUM] ALLOY ZhS6-K WITH ALUMINUM AND TANTALUM OR ALUMINUM AND NIOBIUM. Veksler, Yu. G.; Kupriyanov, I. L. Zashch. Pokrytiya Metal.; No. 5, 124-127(1971). (In Russian).

The advantages of the complex surface saturation of the Ni–Cr alloy ZhS6-K with Al and Ta or Al and Nb are discussed. It is shown that the heat resistance of an aluminized layer created on the Ni–Cr alloy surface by the slip-casting techniques may be varied by introducing Ta or Nb into the composition of the protective layer. It is further demonstrated by metallographic analysis, measurements of microhardness, and a study of the distribution of the elements by x-ray microanalysis and x-ray structural analysis, that the heat resistance of the coating depends on the chemical and phase composition of the layer and hence on the original mixture. (Metals Abstr.)

19266 POINT DEFECTS IN MOLYBDENUM. Kenny, P. N. (Surry Univ., Guildford, Eng.); Heald, P. T. Phil. Mag.; 29: No. 5, 1137-1147(May 1974).

The displacement fields around an isolated vacancy, an interstitial, and a number of divacancy configurations in Mo were calculated using a method of direct minimization of the potential energy of the real-space atomic configuration. The atomic interaction is described by a short-range empirical pair-wise potential which is matched to the elastic constants and the vacancy formation energy (2.2 eV). The interstitial formation energy is found to be 8 eV and the most stable divacancy configuration occurs at a separation of [2,0,0] a with a binding energy of 0.33 eV. (auth)

19267 DISAPPEARANCE OF THE KONDO EFFECT OF Ce IMPURITIES IN (La,Th) BASED ALLOYS. Pena, O.; Meunier, F. (Chile Univ., Santiago). Solid State Commun.; 14: No. 11, 1087-1090(1 Jun 1974).

An experimental study of the resistivity at low temperature of (La, Th) based alloys with Ce impurities is presented. A logarithmic behavior of the resistivity vs temperature at low Th content is observed. When the Th content is increased, the magnetic resistivity is no longer logarithmic but linear with T, and at still higher concentrations of Th, the anomaly in the resistivity disappears. Moreover, the curve of the slope of the logarithmic resistivity vs Th content goes through a maximum for 20% Th before vanishing for 50% Th. (auth)

19268 CHARGE TRANSFER ELECTRONIC STRUCTURE OF ALLOYS. Conference Held in Philadelphia, Pennsylvania, May 1973. Bennett, L. H.; Willens, R. H. New York; Metallurgical Society of the American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc. (1974). 374p. (CONF-730563-).

Two symposia ("Charge Transfer in Alloys" and "Electronic Structure of Alloys") were held on May 29–30. Emphasis was on experimental techniques which can be used to study the elec-

tronic structure of alloys: x-ray diffraction, x-ray photoelectron spectroscopy, electromigration, photoemission, Faraday effect, NMR, Compton effect, positrons, etc. Separate abstracts were prepared for 8 of the 12 papers. Discussions and material and subject indexes are included. (DLC)

For abstracts of individual papers see: 19269–19275 and 19774.

19269 MAGNETIC EFFECTS OF LOCAL CHARGE TRANSFER. Flynn, C. P. (Univ. of Illinois, Urbana). pp 41-68 of Charge Transfer: Electronic Structure of Alloys. Bennett, L. H. New York; Metallurgical Society of the American Inst. of Mining, Metallurgical, and Petroleum Engineers, Inc. (1974).

From symposium on charge transfer in alloys; Philadelphia, Pennsylvania, USA (30 May 1973). See CONF-730563-.

Local charge transfer between host and impurity atoms is discussed for both insulating compounds and metallic host lattices. Alkali metal halide crystals are employed as a simple example of compound host lattices in which the impurity charge state is accurately predictable in terms of the properties of the impurity atoms and the dielectric and other properties of the perfect host lattice. The nature of impurity structure in simple metals is then discussed, and the particular structures associated with local charge transfer identified. Definitive experimental and theoretical results are presented to establish the existence of charge transfer complexes associated with higher-valence impurities in simple metallic hosts. The dielectric function of the host lattice again plays an important part in the stabilization of charge transfer states. Finally, the concept of dynamical charge transfer is introduced and properties associated with this phenomenon are briefly discussed. (37 references) (auth)

19270 ELECTROMIGRATION IN METALLIC SYSTEMS. Rigney, D. A. (Ohio State Univ., Columbus). pp 87-126 of Charge Transfer: Electronic Structure of Alloys. Bennett, L. H. New York; Metallurgical Society of the American Inst. of Mining, Metallurgical, and Petroleum Engineers, Inc. (1974).

From symposium on charge transfer in alloys; Philadelphia, Pennsylvania, USA (30 May 1973). See CONF-730563-.

The more likely contributions to electromigration in liquid and solid metals are briefly discussed. These include such factors as driving force, diffusion, and local binding energy. The driving force is particularly emphasized, especially in liquid alloys. Such systems are thought to be simpler than the corresponding solid alloys, which present complications due to the details of crystalline and defect structure. A simple scattering approach is described and applied to selected liquid alloy systems. Implications for controlling electromigration in thin film circuits are considered. (19 figures, 6 tables, 121 references) (auth)

19271 CHARGE TRANSFER IN BINARY INTERMETALLIC COMPOUNDS WITH THE CaCl STRUCTURE. Moruzzi, V. L.; Williams, A. R.; Marcus, P. M. (IBM Thomas J. Watson Research Center, Yorktown Heights, NY). pp 149-158 of Charge Transfer: Electronic Structure of Alloys. Bennett, L. H. New York; Metallurgical Society of the American Inst. of Mining, Metallurgical, and Petroleum Engineers, Inc. (1974).

From symposium on charge transfer in alloys; Philadelphia, Pennsylvania, USA (30 May 1973). See CONF-730563-.

Self-consistent calculations of charge density in binary metallic compounds are described and results presented for CuZn, NiZn, AlNi, AlCo, BeCu, BeCo at the experimental lattice spacings. Measures of charge transfer are defined by comparison with calculations on the elements for the same structure and lattice spacing as the compound. The calculations suggest that if charge transfer exists in these systems, it is driven by a spilling over of the mobile charge associated with each element. (auth)

19272 PHOTOEMISSION STUDIES OF ALLOYS. Lindau, I.; Spicer, W. E. (Stanford Univ., CA). pp 159-196 of Charge Transfer: Electronic Structure of Alloys. Bennett, L. H. New York; Metallurgical Society of the American Inst. of Mining, Metallurgical, and Petroleum Engineers, Inc. (1974).

From symposium on charge transfer in alloys; Philadelphia, Pennsylvania, USA (30 May 1973). See CONF-730563-.

Photoemission techniques to study the electronic structure of alloys are reviewed. Special emphasis is laid on a comparison between experimental results and the predictions of different alloy theories, as the rigid band model, the virtual crystal approximation, the virtual bound state model and the coherent potential approximation. Photoemission results from; for example, CuNi, AgPd, AgMn, CuPd, AgIn, and CuZn cannot be described with the rigid band model. Instead the virtual bound state model gives a good description for dilute systems of transition metals alloyed into noble metals. The coherent potential approximation appears to give a fair description of the CuNi and AgPd alloys over the entire concentration range. The sampling depth of the photoemission techniques is discussed for a variety of elements. The strong electron energy dependence of the sampling depth (the escape depth of photoemitted electrons) and its shortness have implications for studies of the surface profile compositions of alloys. (118 references, 27 figures) (auth)

19273 FARADAY ROTATION AND THE ELECTRONIC STRUCTURE OF ALLOYS. Stern, E. A. (Univ. of Washington, Seattle). pp 197-222 of Charge Transfer: Electronic Structure of Alloys. Bennett, L. H. New York; Metallurgical Society of the American Inst. of Mining, Metallurgical, and Petroleum Engineers, Inc. (1974).

From symposium on charge transfer in alloys; Philadelphia, Pennsylvania, USA (30 May 1973). See CONF-730563-.

The polar reflection Faraday effect (PRFE) can measure the variation in the shape of the Fermi surface of a class of noble metal-based alloys. This class of alloys has a type of disorder that does not destroy the validity of the concepts of pure materials. The Fermi surface for this class of alloys can be defined and measured for all concentrations and its variation should qualitatively follow the rigid band model. PRFE measurements on AgAu, AgMg, and AgCd alloy systems were performed. The changes in the AgAu alloy system Fermi surface are monotonic and small, permitting calculation by perturbation theory. The changes in the AgMg and AgCd Fermi surfaces are large, requiring calculation by the forward scattering approximation. In their α phases, the variation of the Fermi surface with concentration is the same within experimental error, for AgMg and AgCd. The necks on the (111) Brillouin zone faces expand continuously and somewhat slower than the rigid band model as the concentration increases. No clear evidence is found for second touching within the α-phase in both alloys. The β phase Fermi surface of AgCd has appreciable necks which expand more rapidly with concentration increase than occurs in the α phase. (10 figures, 26 references) (auth)

19274 NUCLEAR MAGNETIC RESONANCE IN CONCENTRATED ALLOYS. Warren, W. W. Jr. (Bell Telephone Labs., Inc., Murray Hill, NJ). pp 223-270 of Charge Transfer: Electronic Structure of Alloys. Bennett, L. H. New York; Metallurgical Society of the American Inst. of Mining, Metallurgical, and Petroleum Engineers, Inc. (1974).

From symposium on charge transfer in alloys; Philadelphia, Pennsylvania, USA (30 May 1973). See CONF-730563-.

Application of NMR to the study of the electronic structure of alloys is reviewed. Basic theoretical concepts of NMR in metals are outlined in the context of the concentrated alloy problem and illustrated with examples drawn from recent experiments in four classes of binary alloy: liquid alkali metal alloys, noble metal-based alloys, liquid metal-chalcogenide alloys, and transition metal alloys. Special attention is devoted to the problem of separating various contributions to the NMR observations so as to relate the data to fundamental electronic structure. In general, this can only be done by introducing additional information from independent experiments or theoretical calculations. The availability of such information should be an important consideration in the design of future experiments. Application of NMR to explicitly metallurgical problems is discussed and the use of NMR in mixed-phase alloys to study phase diagrams is illustrated. (13 figures, 92 references) (auth)

19275 FERMI SURFACE STUDIES OF DISORDERED ALLOYS BY POSITRON EXPERIMENTS. Berko, S. (Brandeis Univ., Waltham, MA). pp 319-342 of Charge Transfer: Electronic Structure of Alloys. Bennett, L. H. New York; Metallurgical Society of the American Inst. of Mining, Metallurgical, and Petroleum Engineers, Inc. (1974).

From symposium on charge transfer in alloys; Philadelphia, Pennsylvania, USA (30 May 1973). See CONF-730563-.

The technique of positron annihilation as applied to solid state studies is reviewed. The angular correlation of the two annihilation photons is directly related to the momentum distribution of the positron–electron system; breaks in this distribution reflect the size and shape of the Fermi surface in pure metals and alloys. After a general introduction to the theory and the experimental techniques used, the experiments measuring various features of the Fermi surface in high concentration disordered alloys are reviewed. (14 figures, 75 references) (auth)

19276 OBSERVATION OF MAGNETIC DOMAINS IN $NdCo_5$ USING AN ELECTRO-ETCHING TECHNIQUE. Evans, D. J.; Garrett, H. J. IEEE (Inst. Elec. Electron. Eng.), Trans. Magnet.; MAG-9: No. 3, 197-201 (Sep 1973).

Magnetic domains have been observed in $NdCo_5$ using an electro-etching technique. Electro etching in an applied magnetic field yields a surface record of the field-related domain structure that

can be viewed using a light microscope without polarizers. High contrast between oppositely magnetized domains can be obtained on surfaces both parallel and perpendicular to the c axis. The effect of increasing the magnetic field to the point where circular or spike domains are obtained is shown and other etching variables are discussed. (Metals Abstr.)

19277 INFLUENCE OF CERIUM CONTENT ON THE STRUCTURE AND MAGNETIC BEHAVIOR OF Co–Fe/Cu–Ce PERMANENT MAGNETS. Nesbitt, E. A.; Chin, G. Y.; Sherwood, R. C.; Green, M. L.; Leamy, H. J. IEEE (Inst. Elec. Electron. Eng.), Trans. Magnet.; MAG-9: No. 3, 203-205(Sep 1973).

As part of a continuing program to understand and optimize the magnetic behavior of Co–Fe–Cu–Ce permanent magnet alloys, a study was made on the alloy system $Co_{2.8}Fe_{0.8}CuCe_x$ with x in the range 0.8 to 1.2. An alloy of x = 1 had previously been studied in detail and found to have good permanent magnetic properties. It was found that when x > 1, the coercive force was increased while both the Curie temperature and saturation magnetization were decreased. However, when x < 1, the coercive force tends to decrease while the Curie temperature saturation magnetization increase. The increase in coercive force with increase in Ce content can be accounted for largely by the decrease in saturation magnetization. These results are in accord with a domain wall pinning mechanism. Scanning electron microscopy studies have shown that a major second phase in the low-Ce alloys is low in Cu as compared with the matrix. On the contrary, the Cu content of the second phase in the high-Ce alloys is larger than that in the matrix. (Metals Abstr.)

19278 INFLUENCE OF SURFACE CONDITIONS ON THE COERCIVE FORCE OF $SmCo_5$ PARTICLES. Searle, C. W.; Frederick, W. G. D.; Garrett, H. J. IEEE (Inst. Elec. Electron. Eng.), Trans. Magnet.; MAG-9: No. 3, 164-167(Sep 1973).

The magnetic properties of single crystals of $SmCo_5$ have been studied. The spontaneous magnetization was 894 electromagnetic units/cm^3 at room temperature. The process of magnetization reversal was extremely sensitive to the surface condition. The magnetization reversal process for spheres with rough surfaces was dominated by free wall motion, while the magnetization for spheres with the smoothest surfaces reversed by means of a jump from the completely magnetized state to the completely reversed state. These latter spheres had an energy product equal to the limiting value of $(BH)_{max}$ = 31.6 MOe. Some preliminary data for $NdCo_5$ and YCo_5 are also presented. (Metals Abstr.)

19279 SOME OBSERVATIONS OF THE MAGNETIC PROPERTIES OF FLUID-QUENCHED Co_5Sm MAGNETS. Doser, M.; Smeggil, J. G. IEEE (Inst. Elec. Electron. Eng.), Trans. Magnet.; MAG-9: No. 3, 168-171(Sep 1973).

The effects of different quenching rates from 900°C on the magnetic properties of liquid-phase sintered Co_5Sm magnets were studied. Various fluids with different thermal conductivities were used to achieve different cooling rates. Interpretations of this behavior were warranted in terms of the microstructures and chemical compositions of the samples examined. Results indicate that the magnetic properties of Co_5Sm magnets are strongly dependent on the particular cooling rate used to come from 900°C to room temperature. (Metals Abstr.)

19280 RARE EARTH PERMANENT MAGNETS. Nesbitt, E. A.; Wernick, J. H. Materials Science Series. New York; Academic Press, Inc. (1973). 209p.

The six chapters deal respectively with: elementary aspects of magnetism; the rare earths and their alloys with Co, Cu, and Fe; magnetic properties of intermetallic compounds; cast magnets of the Co–Cu–Sm and Co–Cu–Ce systems and their modifications; Co_5R magnets based on powders; and comparison of permanent magnet materials. Author and subject indexes are included. (DLC)

19281 SELF-MOTION IN LIQUID SODIUM. Chaturvedi, D. K. (Univ. of Delhi); Baijal, J. S.; Pathak, K. N. Phys. Rev., A; 9: No. 5, 2128-2135(May 1974).

The theory of Singwi and Sjoelander for atomic motion in classical fluids is used to study the self-correlations in liquid sodium. Numerical calculations were done for the velocity-autocorrelation function and its frequency spectrum using two recently developed interatomic potentials. Results are compared with those obtained by Schiff and Rahman from molecular-dynamics experiments. The recent experimental results of Cocking for quasielastic scattering in liquid sodium at 388°K are also analyzed using the results obtained from the above two model potentials. (7 figures) (auth)

19282 TEMPERATURNAYA MIKROSKOPIYA METALLOV I SPLAVOV. (Temperature Microscopy of Metals and Alloys). Lozinskii, M. G. (ed.). Moscow; Izdatel'stvo Nauka (1974). 143p.

A separate abstract was prepared for each of four chapters. Other chapters were not in NSA scope. (JRD)

For abstracts of individual chapters see: 19126 and 19283–19285.

19283 INVESTIGATION OF SOME PROPERTIES OF THE BINARY NIOBIUM–HAFNIUM ALLOY. Gordeeva, L. T.; Pakhomova, E. F.; Ferenets, V. Ya. pp 77-82 of Temperaturnaya Mikroskopiya Metallov i Splavov. Lozinskii, M. G. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

A study was made of the effects of Hf on the structure and properties of Nb at room temperature and at temperatures up to 1100°C. The concentration of Hf in the alloys was varied from 0 to 50 wt %. It was shown that the alloying of Nb with Hf increases the heat resistance of the alloy evaluated by measurement of its hot hardness. During heating up to 1100°C the behavior of the binary alloy is characterized by its stability and comparatively low degree of softening. (tr-auth)

19284 STRUCTURE AND PROPERTIES OF NIOBIUM IN A VACUUM AND IN A RAPID AIR CURRENT. Bogachev, I. N.; Lesnikov, V. P.; Sorokin, V. G. pp 99-103 of Temperaturnaya Mikroskopiya Metallov i Splavov. Lozinskii, M. G. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The microstructural characteristics and some laws on the development of deformation phenomena in the surface layers of Nb at high temperatures were studied. The short-time stability and creep were also studied in comparative tests in a vacuum, stationary air, and in a rapid air current. (tr-auth)

19285 X-RAY STRUCTURE ANALYSIS OF THE STRUCTURAL CHARACTERISTICS OF METALS DURING HIGH-TEMPERATURE DEFORMATION. Malov, V. V. pp 121-125 of Temperaturnaya Mikroskopiya Metallov i Splavov. Lozinskii, M. G. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

A universal x-ray attachment for standard test devices was developed and manufactured. The possibility of using it for the study of the structural changes in Nb during high-temperature creep was shown. It was established that in the annealing process the grain texture changes from mixed to a clearly expressed (110). First order stresses are essentially unchanged. The half width of the interference lines are reduced. (tr-auth)

19286 STUDY OF THE Nb–Co–Si SYSTEM AT 1200°C. Steinmetz, J.; Albrecht, J. M.; Malaman, B. (Univ., Nancy). Compt. Rend., Ser. C; 278: No. 11, 773-775(11 Mar 1974). (In French).

Studies of Nb–Co–Si alloys at 1200°C revealed the existence of a new ternary silicide having a raw composition $Nb_{14}Co_{58}Si_{28}$, and in equilibrium with CoSi, Co_2Si, and E. This silicide, which was obtained in a monocrystalline form by chemical transport, crystallizes in the a = 17.18A, c = 7.92A hexagonal system, five space groups being possible: P622, P6mm, P6(inv.)2m, P6(inv)m2, and P6/mmm. (FR)

19287 MAGNETIC AFTER-EFFECT IN THE INTERMETALLIC COMPOUND $SmCo_5$. Kraposhin, V. S.; Linetskii, Ya. L. Izv. Vyssh. Ucheb. Zaved., Chern. Met.; 3: 128-129 (1973). (In Russian).

Measurements of the demagnetization and the recovery of $SmCo_5$ were made on powdered samples. The absolute value of the coercive force in demagnetizing fields of (0.8 to 1.2) H_c decreased by 15 to 20%. (Metals Abstr.).

19288 OBSERVATION OF NON-METALLIC RARE-EARTH ELEMENT INCLUSIONS. Roshchin, V. E.; Povolotskii, D. Ya.; Nosach, V. F.; Rechkalova, A. V. Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 6, 110-113(1973). (In Russian).

A method is described by which the composition of non-stable rare-earth element inclusions in steel can be determined. Into a liquid soft Fe containing C 0.02 to 0.03, and S 0.004 to 0.006 additions were made of which 93% consisted of rare-earth elements (Ce 60%, La 30% etc.). The stable phases were composed of CeO_2 and $LaAlO_3$. Analyses of non-stable phases were carried out by the 'dry' method. The surface was etched by ions of Ar in an electric field and analyzed under an electron microscope. The method showed the presence of non-stable CeN, CeC_2 and La_2O_2 inclusions. It was concluded that the presence of non-stable inclusions at grains boundaries could be responsible for the strong moderating effect of the rare-earth element on the properties of steels. (Metals Abstr.)

19289 INCREASING THE HEAT RESISTANCE OF A NIOBIUM-BASE ALLOY. Petrovskaya, L. M.; Ponomarenko, E. P.; Kolomytsev, P. T.; Potapov, V. D. Zashch. Pokrytiya Metal.; No. 5, 165-169(1971). (In Russian).

A method of vacuum saturation with Ti, Cr, Si, and various

combinations of these elements, is proposed to increase the heat resistance of Nb-base alloys of various compositions. The structure of the layers so formed is analysed and their microhardness, and the distribution of the individual elements through a thickness of the layer, this being examined with a microanalyser, are established. The best one-component heat resistance is given by silicide coatings (increase of weight 0.045 $g/cm^2 \cdot h$ at 1200°C over 100 h). The best overall effect is given by a combined Ti–Cr–Si coating (0.005 $g/cm^2 \cdot s$ under the same conditions). (Metals Abstr.)

19290 EFFECT OF NON-EQUILIBRIUM CRYSTALLIZATION ON STRENGTH LIMITS OF THE Al–Mn AND Al–Zr ALLOY SYSTEMS. Salli, I. V.; Katkov, V. F.; Kushnereva, A. K. Fiz. Khim. Obrab. Mater.; No. 1, 151-153(1974). (In Russian).

A high cooling rate during crystallization of Al–Mn and Al–Zr alloys significantly increased their strength limits. The strength of Al–Zr (8 wt % Zr) cooled at 10^6 °/s was higher than that cooled at 10^3 °/s. The strength of Al–Mn increased with increase of the Mn from 7 to 7.4 wt % and with the presence of an intermediate phase. (tr-auth)

19291 EFFECT OF RARE EARTHS ON Cr DEFORMABILITY. Zubets, Yu. E.; Manilov, V. A.; Rakitskii, A. N.; Trefilov, V. I. Fiz. Khim. Obrab. Mater.; No. 1, 91-96(1974). (In Russian).

The addition of elements of the Ce subgroup—La, Ce, Pr, and Nd—improved the deformability of Cr, in contrast to alloying with the yttrium subgroup elements—except Gd and Y. The strongest plasticizing action was shown by La. Ductility diagrams were constructed for alloys with the rare earths. Data from electron microscopic analyses of the dislocation structure were used as the basis for a Cr processing technique by which greater strength and low-temperature plasticity is obtained. (tr-auth)

19292 RECRYSTALLIZATION OF Mo AND W WIRES IN HIGH-TEMPERATURE COMPOSITION MATERIAL. Banas, F. P.; Gaiduk, V. V.; Efimenko, L. N.; Natapov, B. S. Fiz. Khim. Obrab. Mater.; No. 1, 139-142(1974). (In Russian).

Recrystallization of reinforcing Mo (type MCh) and W (type VA) wires during prolonged annealing (up to 500 h) in a Ni–Cr matrix (X20H80T) at 1000 to 1250°C was studied to determine the structural stability. The recrystallization depended on the length of time the material was held at this temperature; the surface recrystallized more rapidly than the central part. (tr-auth)

19293 NIOBIUM–GALLIUM BINARY SYSTEM. Feschotte, P.; Spitz, E. L. (Univ., Lausanne, Switzerland). J. Less-Common Metals; 37: 233-246(1974).

The Nb–Ga system was re-examined by thermal analysis (DTA), micrography, microsonde, x-ray analysis, and microhardness methods. The solubility of Ga in Nb varies from 2 at. % at 1200°C to 12 at. % at 1700°C. The nonstoichiometry of Nb_3Ga measured by microsonde on carefully annealed specimens remains constant (19–25 at. % Ga) up to 1500°C, but increases towards higher Ga values (22–26 at. %) at 1700°C. Four other stoichiometric compounds are present: Nb_5Ga_2 (41 at. %, mp; 1800°C), giving an eutectic with Nb_3Ga at 1750°C; Nb_5Ga_4 (48 at. % Ga) melting peritectically at 1500°C, with an allotropic transformation at 1300°C; Nb_2Ga_3 (59 at. % Ga), which is only formed by careful cooling; and finally $NbGa_3$ which is decomposed at 1230°C, with an allotropic transformation at 1110°C. Results are compared with previous studies. (6 fig) (auth)

19294 SOME TERNARY LAVES-PHASES IN THE SYSTEMS OF ALUMINUM AND ZIRCONIUM (OR HAFNIUM) WITH A METAL OF THE VIII GROUP. Marazza, R.; Ferro, R.; Rambaldi, G.; Mazzone, D. (Univ., Genoa). J. Less-Common Metals; 37: 285-288(1974).

Laves phases in the following alloy systems are reported: Hf–Al–Pd, Zr–Al–Pd, Zr–Al–Rh, Zr–Al–Os, Zr–Al–Ir, Hf–Al–Fe, Hf–Al–Co, Hf–Al–Rh, Hf–Al–Ir. (DLC)

19295 ELECTRICAL RESISTIVITY OF NIOBIUM OVER THE TEMPERATURE RANGE 20°K TO THE MELTING POINT. Abraham, J. M.; Tete, C.; Deviot, B. (Ecole des Mines, Nancy). J. Less-Common Metals; 37: 181-188(1974).

Previous measurements (J. Less-Common Metals, 29: 311(1972)) were analyzed. It is shown that Mott's theory is obeyed at high temperature in niobium. In particular, the resistivity curve reflects the variation of the density of states at the Fermi surface when the temperature is raised, thus demonstrating the predominance of s–d transitions. In addition, it is not possible to fit a Bloch–Grueneisen or Wilson relation to the experimental curve. Several arguments are advanced to indicate that even a rough approximation of the Debye temperature has no physical significance and that it is necessary to take the U process into account. (auth)

19296 INTERMEDIATE PHASES CRYSTALLIZING IN THE $MoSi_2$ STRUCTURE. Raynor, G. V. (Univ. of Birmingham, Eng.). J. Less-Common Metals; 37: 247-255(1974).

The $MoSi_2$ type phases (AB_2) were examined with particular reference to those for which sufficient constitutional data exist to permit the estimation of a stability index (I), the variation of which, with atomic radius ratio, the group numbers of the components, and the electronegativity differences between the components, is discussed. The behaviour of the group with axial ratio >3 differs from that of the group with low axial ratios (<3). Consideration of the crystal structure in terms of a simplified model again suggests that the two groups are distinct. The high axial ratio group appears to depend upon the packing of planar square networks one upon the other; the closest distance between atoms within these networks is closely similar to the diameter of the B atom (d_B) and the distance between unlike atoms in different planes (d_{AB}), in general, equals the sum of the radii of the A and B atoms ($R_A + R_B$). In contrast, for the low axial ratio group the c spacing is closely similar to ($d_A + 2d_B$) while $d_{AB} < (R_A + R_B)$, suggesting that the structure may be interpreted as chains of atoms in contact in the c direction packed closely side by side. A possible reason for the existence of the two groups is discussed in terms of the directional properties of hybrid bonds. (7 fig) (auth)

19297 MAGNETIC–NONMAGNETIC TRANSITION OF CERIUM IMPURITIES IN LANTHANUM–THORIUM BASED ALLOYS. Meunier, F.; Ortega, S.; Pena, O.; Roth, M.; Coqblin, B. (Chile Univ., Santiago). Solid State Commun.; 14: No. 11, 1091-1096 (1 Jun 1974).

A simple theoretical model which assumes a linear increase with thorium content for the cerium 4f level with respect to the Fermi level can explain both the decrease $\Delta T_c/c$ of the superconducting temperature and the logarithmic slope $d\rho/cdlnT$ of the Kondo resistivity in La–Th based alloys with cerium impurities. The model yields two different maxima for $d\rho/cdlnT$ and $\Delta T_c/c$, the second one of which occurs when the resistivity minimum disappears, in very good agreement with experimental data. (auth)

19298 STUDY OF THE PROPERTIES OF URANIUM–COBALT ALLOYS BY THE E.M.F. METHOD. Lebedev, V. A.; Nazarov, N. V.; Pyatkov, V. I.; Nichkov, I. F.; Raspopin, S. P. Elektrokhimiya; 9: No. 7, 920-926(Jul 1973). (In Russian).

The thermodynamic properties of U–Co alloys were studied by measuring the change in potential of the alloys with temperature in the range 600 to 900°C, and with time, in molten electrolytes of alkali metals containing UCl_3 5 wt %. From the nature of the change in potential, conclusions were drawn on the number of phases in the system, the activity of U in the two-phase state, and on the energy of interaction of U with Co. The alloying of U with Co is accompanied by the evolution of an appreciable amount of heat with a decrease in entropy and free energy. The values of ΔH and ΔS are constant over the range of alloy composition U 33.3 to 43.7 at.%. The activity of U in all the regions of the composition diagram studied is less than its atomic fraction, except for alloys containing U 43.7 to 63.0 at. %, which have a small positive deviation from Raoult's law. (Metals Abstr.)

19299 VLIYANIE FIZIKO-KHIMICHESKOI SREDY NA ZHAROPROCHNOST' METALLICHESKIKH MATERIALOV. (Effect of the Physical-Chemical Medium on the Heat Resistance of Metallic Materials). Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). 198p.

Thirty-seven papers are included in the book. A separate abstract was prepared for each of twelve papers. Papers for which no abstracts were prepared are not in scope of NSA. (JRD)

For abstracts of individual papers see: 19137, 19138, 19200–19205, and 19300–19303.

19300 EFFECT OF RAREFIED GAS FLOW ON THE HIGH-TEMPERATURE MECHANICAL PROPERTIES OF METALS. Ivanov, L. I.; Abramyan, E. A.; Kazilin, E. E. pp 109-113 of Vliyanie Fiziko-Khimicheskoi Sredy na Zharoprochnost' Metallicheskikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The effects of rarefied molecular flows of oxygen at different intensities (10^{16} to 10^{18} molecules/s) on the steady-state high-temperature creep during torsion of Nb, Ta, and V was studied in a wide interval of temperatures and stresses. An abrupt increase of the creep rate of Nb, Ta, and V was observed at the moment of the input of O_2. By local laser analysis it was established that this effect is connected with the diffusion of O_2 on atoms formed in the process of dislocation deformation. (tr-auth)

19301 ROLE OF SLIPPAGE AT THE GRAIN BOUNDARIES DURING THE HIGH-TEMPERATURE CREEP OF TUNGSTEN. Mordyuk, V. S.; Ruchin, V. I.; Sinitsyn, G. F. pp 113-117 of

Vliyanie Fiziko-Khimicheskoi Sredy na Zharoprochnost' Metallicheskikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

The results of the study of slippage at the grain boundaries W wires with different impurity concentrations were reported. The contribution of the grain boundary dislocations to the general elongation during creep was evaluated at temperatures from 2200 to 2800°C. (tr-auth)

19302 PHASE CONVERSIONS IN CHROMIUM–MOLYBDENUM AND CHROMIUM–MOLYBDENUM–VANADIUM STEEL. Mirkin, I. L.; Trusov, L. P.; Bogomolova, N. A.; Marinenko, L. S. pp 137-141 of Vliyanie Fiziko-Khimicheskoi Sredy na Zharoprochnost' Metallicheskikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

A study was made of the effect of temperature-time factors on the stability of the secondary phase controlling the structure and properties of Cr–Mo and Cr–Mo–V low-alloyed heat resistant steel. The intensity of the change of secondary characteristics of the steel during extended use was determined by precipitation processes and the secondary dissolution of the carbide phase, by the ratio of different types of carbides simultaneously present in the steel, and by the variation of the parameters of the carbide phase. The integral effect of the temperature-time factors leads to a condition of the carbide phase which, according to the concentration of C, alloying elements, and crystallochemical types of carbides, has a stable phase diagram. (tr-auth)

19303 SOME LAWS OF THE DIFFUSION IN ALLOYS OF REFRACTORY METALS. Shinyaev, A. Ya.; Kopaleishvili, N. I. pp 180-183 of Vliyanie Fiziko-Khimicheskoi Sredy na Zharoprochnost' Metallicheskikh Materialov. Savitskii, E. M. (ed.). Moscow; Izdatel'stvo Nauka (1974). (In Russian).

On the basis of the results of the analysis of literature data on the mutual diffusion of refractory metals it was concluded that the basic reason for the wide dispersion of the experimental data is the effect of intercrystalline diffusion. Data obtained on multicrystalline samples agree well with literature data when the annealing diffusion temperature is 80 to 95 of the fusion temperature. The existence of a linear concentration dependence of the mutual diffusion coefficient was observed when the components of the diffusion zone differ in their fusion temperature at 800 to 1000°C. This is illustrated by measurement of the diffusion pairs W–Nb and W–Mo. In these a linear dependence occurs for the Nb and Mo side. (tr-auth)

19304 MECHANICAL PROPERTIES OF MULTICOMPONENT ALLOYS BASED ON AN ALPHA SOLID SOLUTION OF TITANIUM–ALUMINUM–TIN (OR ZIRCONIUM) WITH BETA-STABILIZING ELEMENTS. Mikheev, V. A. Probl. Prochnosti; No. 10, 89-92 (Oct 1973). (In Russian).

The mechanical properties of multicomponent Ti alloys based on Ti–Al–Zn and Ti–Al–Zr solid solutions of the α type also containing β-stabilizing elements totalling 10 to 30% of the whole composition were studied at 20 to 900°C. The optimum proportions of the alloying elements, designed to produce the most favorable combination of strength, ductility, and machineability, were fairly critical. Increasing the Al content from 7 to 9% increased the hardness from 300 to 380 Bhn and sharply reduced the ductility, and increasing the Zr content had a similar effect. The mode of heat treatment had an even greater effect; the most favorable conditions included annealing at 1000, water quenching, and aging at 500°C, when the strength rose to 170 kg/mm^2 without detriment to the ductility. (Metals Abstr.)

19305 TUNGSTEN-BASE MATERIALS FOR DIE-CASTING DIES. Frazier, R. T.; Borbely, A.; Lawrence, J. R. Giessereipraxis; No. 10, 198-192(25 May 1973). (In German).

Tungsten-based materials with 90% W, 4% Ni, 4% Mo and 2% Fe yield an optimum combination of yield strength and elongation. The alloy consists of W grains embedded in a Ni–Fe–Mo matrix. Values of 970 newtons/mm^2 for tensile strength and 860 newtons/mm^2 for 0.2 yield strength are obtained with a 3% elongation. Results of tests with brass die casting are presented. Welding rods with 60% W, 26.5% Ni, and 13.5% Fe were developed. The Tig welding process is used in die repair work. Carbon-containing surface coatings improve the resistance to erosion in Al die casting of the W die material. (Metals Abstr.)

19306 DECOMPOSITION OF HIGHLY SUPERSATURATED SOLID SOLUTION OF GRANULATED ALLOY ALUMINUM–1.5% CHROMIUM–1.5% ZIRCONIUM. Imanow, C.; Gorozyca, S.; Przyblowicz, K. Arch. Hutn.; 17: No. 4, 315-326(1972). (In Polish).

The investigation was carried out with granules obtained by pouring the molten alloy into water. Using optical and electron microscope techniques, x-ray, electron microprobe, and microhardness measurements, the structure of the granules was analyzed in "as-cast" form, after annealing at various temperatures up to 680°C and after plastic deformation. The results showed that Cr and Zr are precipitated in different phases, probably as Al_7Cr and Al_3Zr. First signs of precipitation were detected at 250°C as finely dispersed Al_7Cr appeared in the microstructure of the alloy. At 450°C Al_3Zr started to precipitate simultaneously with Al_7Cr, both phases differing in shape and size. At 600 to 650°C the growth of sub-grains takes place, followed by coagulation of the particles and formation of grains with wide-angle boundaries. The observations made during the investigation have suggested an explanation of the high resistance to creep of the material made of the pressed and sintered granules of this alloy. (Metals Abstr.)

19307 EFFECT OF ADDITIONS OF TRANSITION METALS ON THE ALPHA → BETA SHIFT OF THE POLYMORPHIC TRANSFORMATION OF ZIRCONIUM. Fillipov, V. F. Sb. Nauch. Tr., Tomsk. Inzh.-Stroit. Inst.; 21: 138-140(1973). (In Russian).

A study was made of the effect of transition metals on the high temperature bcc β-region of Zr. The β-phase region is broadened by transition metals having ≥2 electrons in the d shell, but contracted by those with a single d electron, e.g., Sc, Y, or La. (Ref. Zh.)

19308 ROLE OF LOW CERIUM ADDITIONS DURING THE SOLIDIFICATION OF IRON. Sukhodol'skaya, E. A. Liteinoe Proizvod.; No. 5, 36-37(May 1973). (In Russian).

Small additions of ferro-cerium affect the macro and microstructures of cast iron. The depth of surface chill is sharply reduced with such additions in the range 0.02 to 0.15%. An addition of 0.05% ferro-cerium reduces the H_2 and O_2 contents by 20 to 40%. It is concluded that small additions of Ce reduce the degree of eutectic supercooling as a result of the formation of secondary graphitization centers, and an increase in the temperature of the beginning of the solidification of the eutectic. (Metals Abstr.)

19309 LEVEL OF THE EQUICOHESION TEMPERATURE OF THE MOLYBDENUM ALLOY VM-1A FOR SHORT TESTS IN VACUUM. Konoplenko, V. P.; Artyukhina, L. L.; Ovsepyan, E. S.; Vinogradova, V. S. Probl. Prochnosti; No. 10, 51-55(Oct 1973). (In Russian).

Difficulties inherent in determining the mechanical properties of Mo and Mo alloys at high temperature in vacuum are discussed. Such materials are extremely susceptible to gas saturation, and the absorbed gases seriously affect the mechanical properties of the surface layers as a result of their loss of cohesion. In a vacuum of 5×10^{-5} torr the equicohesion temperature of the Mo alloy VM-1A, for example, is 1250°C. On reducing the amount of residual O by repeatedly flushing the test chamber with Ar this value rises to 1450°C. If the sample surface is also protected with $MoSi_2$ the equicohesion temperature rises above 1500°C. (Metals Abstr.)

19310 MAGNETIC PROPERTIES OF Co–Fe–Nb ALLOYS FOR REMANENT REED SWITCHES. Okada, M.; Kassai, M.; Sasaki, T.; Henmi, Z. (Fujitsu, Labs., Kawasaki, Japan). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 730-734(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

Previous studies revealed that an 85Co–12Fe–3Nb wire for a remanent reed switch showed a coercive force of 20 Oe. The magnetic properties of Co–Fe–Nb alloys containing 6 ~ 18 wt %, Fe, 0 ~ 7 wt % Nb, and the balance Co, were further investigated. Wires were made by a serial process of solution treatment at 1200°C, cold drawing and aging at 700°C for 1 hour. The value of coercive force increases linearly with Nb content, and reaches 48 Oe at 7 wt % Nb. The magnetic moment decreases linearly with Nb content from 172 to 132 emu/g. Changes in coercive force and magnetic moment with Fe content are not so large as those with Nb content. The magnetostriction constant, however, changes with Fe content and becomes nearly zero as Fe approaches 9 wt %. The squareness ratio (Br/B_{100}) is higher than 0.90 for all the specimens except for the specimen with 7 wt % Nb. It was clarified by x-ray diffractometer and electron microscope that the increase in coercive force with Nb is due to fine precipitates of Co_3Nb in the grain. (auth)

19311 ELECTRON SPIN RESONANCE OF Gd IN $Ce_xLa_{1-x}Ru_2$. Baberschke, K.; Engel, U.; Koopman, G.; Huefner, S. (Freie Univ., Berlin). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 984-988(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

Electron spin resonance measurements on Gd in the superconducting alloy $Ce_xLa_{1-x}Ru_2$ ($0 \leq x \leq 1$) show a strong change in the

g-shift and in the thermal line broadening at high La concentrations. This is attributed to the formation of a d- or f-band close to the Fermi energy. The data can be correlated with the superconducting properties, as shown previously in $CeRu_2$, $LaRu_2$, and $ThRu_2$. (auth)

19312 ELECTRON SPIN RESONANCE OF Gd IN $LuAl_2$. Rettori, C.; Davidov, D.; Kim, H. M.; Chock, E. P. (Univ. of California, Los Angeles). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 989(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

Electron spin resonance spectra of Gd in $LuAl_2$ exhibit significant changes in g shift (Δg) and thermal broadening of the linewidth, ($\Delta H/\Delta T$) upon (a) varying the concentration of magnetic impurity (Gd); (b) adding a second non-magnetic impurity (Th); and (c) lowering the temperature (down to 0.52°K). When the Gd concentration was reduced from 2% to 20 ppM the g value and thermal broadening were shifted from $\Delta g \simeq 0$ and $\Delta H/\Delta T$ (20 ± 3) G/°K to $\Delta g_0 = +0.085 \pm 0.005$ and $(\Delta H/\Delta T)_k = (75 \pm 10)$ G/K. The same effect was found by adding Th as a second impurity. Both the g shift and the thermal broadening show appreciable temperature dependence in the range of $0.52 < T < 6$°K. The results are interpreted in terms of Hasegawa's theory for bottleneck and dynamic effects. Assuming that the exchange interaction J_{fs} does not depend heavily on the conduction electron momentum transfer, the unbottleneck g shift (Δg_0) and Korringa rate $(\Delta H/\Delta T)_k$, the electron–electron exchange enhancement parameter $\alpha = 0.61$, and in turn the exchange interaction $J_{fs} = 0.11 \pm 0.02$ eV were estimated. The presence of bottleneck in $LuAl_2$:Gd allows extraction of the following relaxation rates: the conduction electron-lattice relaxation rate in "pure" $LuAl_2$ $\delta^0_{sL} = (90 \pm 10) \times 10^{10}$ sec^{-1} the spin-flip scattering rate at the Gd impurities $\delta^1_{sL} = (1.6 \pm 0.5) \times 10^7$ sec^{-1}/ppM and the spin-flip scattering rate at the Th impurities $\delta^2_{sL} \simeq (3 \pm 1) \times 10^7$ sec^{-1}/ppM. Bottleneck effects have been previously observed in the isolectronics systems $LaAl_2$:Gd and YAl_2:Gd. A comparison between the three systems is given in terms of recent band calculations by Switendick. (auth)

19313 MAGNETIC AND MAGNETOELASTIC PROPERTIES OF HIGHLY MAGNETOSTRICTIVE RARE EARTH-IRON LAVES PHASE COMPOUNDS. Clark, A. E. (Naval Ordnance Lab., White Oak, MD). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1015-1029(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

The rare earth-Fe_2 (RFe_2) compounds possess huge magnetic anisotropies and magnetostrictions at room temperature. This, coupled with a relatively high Curie temperature and magnetic saturation, makes these alloys attractive for various applications, including magnetostrictive transducers and permanent magnets. A variety of measurements on single crystals, polycrystals and the amorphous forms of the RFe_2 alloys are reported. These include magnetization, magnetic anisotropy, magnetostriction, elastic moduli, and resistivity. Saturation moments (from single crystal measurements) are substantially higher than polycrystalline values previously reported. For $ErFe_2$, the T = 0 anisotropy constant $K_1(0)$ is calculated to be -5.4×10^8 ergs/cm^3. Torque measurements on $DyFe_2$ at room temperature yield $K_1 = 2 \times 10^7$ ergs/cm^3, a large value for a cubic material at room temperature. Measured values are reported for the magnetostriction of RFe_2 compounds, where R = Sm, Tb, Dy, Er, and Tm. Notable are $TbFe_2$ and $SmFe_2$ which stand out as giants with room temperature values of magnetostriction, λ, greater than 2000 ppM. A maximum magnetostriction/anisotropy ratio, λ/K_1, was found for the pseudobinary compound $Tb_xDy_{1-x}Fe_2$ with $x \simeq 0.3$. Rapidly sputtered (amorphous) $TbFe_2$ and $DyFe_2$ have high magnetizations at absolute zero, although they are not as magnetic as the corresponding polycrystals at room temperature. A striking feature is the high coercivity (~30 kOe) at low temperatures. Materials with anisotropic hysteresis loops and intrinsic coercivities >3 kOe were obtained after heat treatments in a magnetic field. (auth)

19314 X-RAY PHOTOEMISSION STUDIES OF RARE EARTH HARD MAGNETS. Cuthill, J. R. (National Bureau of Standards, Gaithersburg, MD); McAlister, A. J.; Erickson, N. E.; Watson, R. E. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1039-1043 (1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

The electronic properties of the RCo_5 compounds by x-ray photoelectron spectroscopy studies of $SmCo_5$ and $PrCo_5$. The results are related to the properties of the pure metals and to the picture developed to describe the magnetism of the compounds. The results indicate a valence band structure which is similar to that of Co metal; there is the suggestion that if there is charge flow it is off the rare-earth sites; there appears to be significant change in the 4f spectra from that of the pure rare-earth metals; and there is a suggestion of f–d hybridization. (auth)

19315 BAND MODEL FOR HEUSLER ALLOYS. Bahurmuz, A. A.; Zuckermann, M. J. (McGill Univ., Montreal). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1059(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

The band structure of Heusler alloys is simulated by a free electron conduction band which hybridizes with a flat band due to the "magnetic" ions (e.g. Mn in Cu_2, Mn, Al). The magnetic properties are due to a Coulomb repulsion between electrons of opposite spin in the flat band. The condition for the occurrence of ferromagnetism and the Curie temperature are calculated in the Hartree–Fock approximation. The spin wave dispersion relation is obtained from the dynamic susceptibility in the random phase approximation. The experimental methods are discussed. (auth)

19316 RADIATION INDUCED BROADENING OF THE FMR AND AFMR UNIFORM MODES. Rezende, S. M. (Univ. Federal de Pernambuco, Recife, Brasil); Soares, E.; Jaccarino, V. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1083-1087(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

Magnetic-dipolar, radiation-induced broadening of the ferromagnetic resonance is observed for highly polished YIG spheres in both "free-space" and shorted wave guide configurations. A quantitative comparison with the classical theory of the frequency and volume dependence is obtained. As expected, most magnetostatic modes appear to suffer little such broadening. The corresponding radiation width for the antiferromagnetic resonance is derived and it is suggested that this mechanism is the primary source of the uniform mode broadening that was observed in both earlier and more recent AFMR experiments on MnF_2. (auth)

19317 DYNAMIC MEASUREMENTS OF THERMOMAGNETIC REVERSAL IN Gd–Co FILMS. Wieder, H. (IBM Research Lab., San Jose, CA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1128-1132(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

The dynamic magnetization reversal which occurred during laser-induced thermomagnetic recording in films of Gd–Co was measured as a function of the position of a probe beam which was moved progressively along the coordinate of the spot. In films whose compensation temperature was well below ambient (ΔT = 120°C), the onset of reversal occurred at the same temperature throughout the spot. In films for which the compensation temperature was only slightly below ambient ($\Delta T \simeq 20$°), no such correlation was observed. In such films an increase in peak temperature within the spot leads progressively from transient to permanent reversal of the spot. These differences in behavior are attributed to differences in the magnetostatics for the two cases. For the sample having small ΔT, reversal may occur in two steps, with the slower step persisting for as long as 2 μs. This is tentatively explained as originating from a highly undamped spin precession during reversal. (auth)

19318 THERMAL DECOMPOSITION AND MAGNETIC BEHAVIOR OF Co_5Sm. Smeggil, J. G.; Rao, P.; Livingston, J. D.; Koch, E. F. (General Electric Corp., Schenectady, NY). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1144-1148(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

Co_5Sm is observed to be unstable at 750°C on the basis of transmission electron microscopy studies of thermally aged alloys. The decomposition products observed are $Co_{17}Sm_2$(r) precipitates and crystallographic shear (CS) planes constituting a disordered Co_7Sm_2-type structure. The possible effects of these products on the magnetic properties of the Co_5Sm matrix are discussed. (auth)

19319 ANNEALING RESPONSE OF Sm–Co MAGNETS AND ITS DEPENDENCE ON COMPOSITION AND PROCESSING. Welhrauch, P. F.; Das, D. K. (Raytheon Co., Waltham, MA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1149-1153(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

The annealing response of samarium-cobalt magnets and its dependence on alloy composition, pre-sintered particle size, and

sintering temperature is described. The data are presented on plots of annealing temperature vs composition as lines of constant coercive force for a range of annealing temperatures of 650 to 1050°C and for a range of hyperstoichiometric $SmCo_5$ compositions of 34 to 37% Sm. These plots indicate that the annealing response is altered by small changes in composition and processing and that by process control high coercive force and squareness can be obtained over a wider interval of annealing temperatures. (auth)

19320 INFLUENCE OF SAMARIUM CONTENT ON THE STRUCTURE AND MAGNETIC BEHAVIOR OF Co–Fe–Cu–Sm PERMANENT MAGNET ALLOYS. Nesbitt, E. A.; Chin, G. Y.; Sherwood, R. C.; Green, M. L. (Bell Labs., Murray Hill, NJ). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1159–1162(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

Magnetic measurements have been made on the system $Co_{3.3}Fe_{0.3}Cu_{1.3}Sm_x$, with x from 0.8 to 1.5. The Curie temperature T_c at x = 0.8 is ~870°C and decreases nearly linearly to ~700°C at x = 1.4. The saturation magnetization $4\pi M$ follows the same trend, decreasing from a value of ~6700 G at x = 0.8 to ~3000 G at x = 1.5. After aging at 400°C, the intrinsic coercive force $_MH_c$ is ~4000 Oe at x = 0.8, rises sharply to ~10,000 Oe at x = 1, and thereafter decreases gradually to ~6000 Oe at x = 1.5. The observed behavior differs from that of the analogous Ce system in several aspects. (auth)

19321 THERMAL STABILITY AND TEMPERATURE COEFFICIENTS OF SINTERED SAMARIUM-COBALT MAGNETS. Mildrum, H. F.; Hartings, M. F.; Strnat, K. J. (Univ. of Dayton, OH). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1163-1167 (1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

Certain engineering parameters of commercial $SmCo_5$ permanent magnets are reported: Temperature coefficients between –100 and +300°C, irreversible losses, the long-term stability at temperatures between 25 and 300°C, and hysteresis loops before and after exposure to differentiate permanent structural from magnetic aging. Cycling and aging data are for open-circuit remanent flux on cylinders having $B_d/H_d \approx 1$. Reversible coefficients are about –.031%/°C at –100, –.037 at 25 and –.060 at 300°C. Irreversible losses are 1.7 to 13% on initial heating between 150 and 300°C. Aging at 300°C is very rapid, but at 200°C and below the stability is satisfactory for many device uses. Temperature coefficients fall within narrow limits, but initial magnetic properties, aging behavior, and irreversible losses showed extremely wide variations. (auth)

19322 REVERSIBLE AND IRREVERSIBLE LOSSES OF MAGNETIZATION IN $SmCo_5$ MAGNETS. Bachmann, K. (Brown Boveri and Co., Ltd., Baden, Switzerland). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1168-1172(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

Changes in magnetization occurring in permanent magnets at elevated temperatures are of great importance for all practical applications. The reversible and irreversible losses of magnetization which occur in sintered $SmCo_5$-magnets due to a heat treatment at elevated temperatures both for short and extended periods of time were studied. The reversible changes of magnetization in the vicinity of room temperature can be described by a temperature coefficient of approximately –0.04%/°C. The irreversible losses due to short-time exposure at elevated temperatures depend on the difference between the intrinsic coercive field and the internal field at the highest temperature to which the magnet is heated. The temperature dependence of the coercive field limits the range of applications of $SmCo_5$-magnets to temperatures below 400°C. (auth)

19323 Co–Gd–Sm PERMANENT MAGNET WITH A ZERO TEMPERATURE COEFFICIENT OF MAGNETIZATION. Benz, M. G.; Laforce, R. P.; Martin, D. L. (General Electric Corp., Schenectady, NY). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1173-1176(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

The magnetic properties of $Co_5(Gd_xSm_{1-x})$ alloys were studied as a function of Gd content over the temperature range –200 to +225°C. From this study it has been determined that alloys with $x \approx 0.42$ have an essentially zero reversible temperature coefficient of magnetization. One alloy with x = 0.425 had a reversible temperature coefficient of +0.0015% per °C over the range 0 to 100°C, and the following magnetic properties: B_r 6.35 kGauss, H_c – 5.67 kOe, and $(BH)_{max}$ 9.3 MGOe. (auth)

19324 MAGNETIC PROPERTIES OF RE Co_5 SINGLE CRYSTALS. Klein, H. P.; Menth, A. (Brown Boveri Research Center, Baden, Switzerland). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1177-1181(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

Single crystals of Y-, Sm-, Ce-, Nd-, and $CeMMCo_5$ (CeMM representing the natural ore of Ce, La, Pr, or Nd) were prepared in an rf-furnace by fast cooling of a stoichiometric melt and subsequent heat treatment. They have been studied using conventional vibrating and torque magnetometer techniques. The magnetization in both easy and hard direction was measured as a function of the applied field and the temperature between 77°K and the ferromagnetic Curie point. The experimental results were evaluated by means of a model for uniaxial magnetic compounds proposed by Néel. This provides a consistent description of the experimental results and allows the relevant crystal anisotropy constants at different temperatures to be determined as well as the temperature dependence of the magnetization and the ordering temperature. (auth)

19325 HIGH TEMPERATURE X-RAY STUDIES OF $SmCo_5$. Jennings, L. D.; Chipman, D. R. (Army Research Center, Watertown, MA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1187-1191(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

Studies of the time and temperature dependence of the position and shape of x-ray diffraction lines have been carried out on aligned sintered compacts of $SmCo_5$. Several types of transformations were observed in the range 600 to 925°C. Some of this behavior may be attributed to surface deterioration with Sm loss, but at least one transformation had lattice constant shifts corresponding to a Sm enrichment of the starting material. Thus this transformation, at least, was attributed to fundamental properties of the sample. If the transformations were incomplete, the lines were broadened because of the mixed state. Even in a pure state, including the untransformed state, the lines were broadened as the temperature was lowered in a way so as to suggest high stress levels. In spite of the transformations, estimates were made of the thermal expansion. In the range 0 to 900°C, da/adT increases smoothly from 13 to 18 whereas dc/cdT is 5 below the Curie temperature and 13 above it (all in units of 10^{-6}/deg). Debye-Waller factor measurements can be interpreted through a Debye temperature of 281°K for basal plane motion and 264°K for c axis motion. (auth)

19326 MAGNETOSTRICTION IN SINGLE CRYSTAL $SmCo_5$. Doane, D. A.; Graham, C. D. Jr. (Univ. of Pennsylvania, Philadelphia). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1192-1196(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

The room temperature magnetostriction in a c-axis disk of single crystal $SmCo_5$ was measured in the basal plane parallel to a magnetic field of up to 21.0 tesla, using a strain gage technique. Over this range of field, the data satisfactorily fit a curve of the form $\lambda = -(0.475 \pm 0.006)(\mu_0 H)^2 \times 10^{-6}$, with $\mu_0 H$ in tesla. If θ is defined as the angle by which the magnetization is rotated away from the c-axis, the data can also be represented by $\lambda = \lambda_A \sin^2 \theta$, where $\sin \theta = H/H_A$, and H_A is the anisotropy field. Using $\mu_0 H_A = 34$ tesla, obtainable from values of K_1 and M_s reported by Tatsumoto et al.,[J. Physique 32 C1-550(1970)] it is inferred that $\lambda_A = -550 \times 10^{-6}$, ±5%. (auth)

19327 MAGNETIC PROPERTIES OF SINGLE CRYSTAL $NdCo_5$. Frederick, W. G. D. (Air Force Materials Lab., Wright-Patterson AFB, OH); Searle, C. W.; Hoch, M. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1197-1201(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

The magnetization parallel and perpendicular to the c-axis of a $NdCo_5$ single crystal was measured over the temperature range from 4.2 to 950°K using a vibrating sample magnetometer. It was found that the magnetization begins to leave the c-axis at 277°K and exhibits easy cone behavior until 230°K where the magnetization moves into the basal plane. The temperature dependence of the anisotropy constants K_1 and K_2 was investigated using the analysis of Callen and Callen and it was concluded that this model cannot be used to describe the temperature dependence of the

anisotropy. In addition, it was found that $NdCo_5$ has a measurable anisotropy in the basal plane at 4.2°K and the value of K_4 was calculated to be 1.0×10^6 ergs/cm³. (auth)

19328 TIME EFFECTS IN Co_5Ce POWDERS. Roy, G.; Gaunt, P. (Univ. of Manitoba, Winnipeg). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1202-1206(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

Co_5Ce permanent magnet powders were aligned in a forward field of 17 kOe. After application of a steady reverse field the decrement in magnetization, with time since reversal, was measured. The magnetization decrement was found to be proportional to the natural logarithm of time over a range of about 1 to 1000 seconds. The constant of proportionality, S, was a maximum for fields close to the coercive field. For 3 μm and 8 μm particles the constant S changed on cooling below room temperature first rising slightly and then falling as the sample was cooled to about 80°K. The classical thermal activation model predicts that S should be directly proportional to the absolute temperature. A field dependent form of the activation energy is suggested to explain the results. (auth)

19329 HEAT CAPACITY OF $CeCo_5$, $PrCo_5$, $NdCo_5$, $SmCo_5$, AND $GdCo_5$ FROM 5–300 K. Keller, D. A.; Sankar, S. G.; Craig, R. S.; Wallace, W. E. (Univ. of Pittsburgh). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1207-1211(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

The heat capacity, C_p, of $CeCo_5$, $PrCo_5$, $NdCo_5$, $SmCo_5$, and $GdCo_5$ were measured from 5 to 300°K. C_v^m, the "magnetic" contribution to C_p, was estimated "experimentally", using the heat capacity of $LaNi_5$ as a "blank". C_v^m was also estimated theoretically, assuming a model which considered the crystal field and molecular field interactions of the rare earth ion. Although most of the gross features of C_v^m(expt) vs temperature, T, could be qualitatively reproduced using a point charge-plus-molecular field model, some significant features remain unexplained. The magnetic moment of the rare earth sublattice vs T was also estimated. (auth)

19330 MAGNETIC ANISOTROPY OF R_2Co_{17} COMPOUNDS (R = Er, Tm, Yb). Narasimhan, K. S. V. L. (Univ. of Pittsburgh); Wallace, W. E.; Hutchens, R. D.; Greedan, J. E. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1212-1216(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

Saturation moments, easy direction of magnetization, anisotropy field, and anisotropy constants have been determined at 4.2°K and room temperature for Er_2Co_{17}, Tm_2Co_{17} and Yb_2Co_{17}. The data obtained are compared with theoretical predictions. Y and Pr were substituted for Tm in Tm_2Co_{17} to study site preferences and variations in the anisotropy field. The results indicate the C axis is retained in $TmYCo_{17}$ and $TmPrCo_{17}$ and the anisotropy field shows a slight increase in the Pr substituted ternaries. (auth)

19331 MAGNETIC MEASUREMENTS ON SINGLE CRYSTALS IN THE $Y_2(Co_{1-x}Fe_x)_{17}$ AND $Pr_2(Co_{1-x}Fe_x)_{17}$ SYSTEMS. Shanley, C. W.; Harmer, R. S. (Univ. of Dayton, OH). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1217-1221(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

Single crystals of the compositions $Y_2(Co_{1-x}Fe_x)_{17}$, x = 0.1, 0.2, 0.4, 0.5, and $Pr_2(Co_{1-x}Fe_x)_{17}$, x = 0.2, 0.3, 0.4, were grown from single phase alloy buttons by long term annealing. Measurements of the room temperature and liquid nitrogen temperature saturation magnetization and anisotropy were made with an oscillating specimen magnetometer. The temperature variation of the magnetization was also investigated. All of these alloys have the magnetically favorable c-axis magnetocrystalline anisotropy at room temperature. It was found, however, that cooling $Pr_2(Co_{0.8}Fe_{0.2})_{17}$ below 140°K in a kOe field caused this composition to develop an easy direction of magnetization in the basal plane of the hexagonal cell. The highest saturation magnetization observed was for $Pr_2(Co_{0.7}Fe_{0.3})_{17}$, (16,300 Gauss). This alloy also had the highest room temperature anisotropy field. (auth)

19332 HIGH TEMPERATURE MOESSBAUER STUDY OF RFe_2 LAVES PHASES. Kimball, C. W.; Dwight, A. E.; Preston, R. S.; Taneja, S. P. (Northern Illinois Univ., DeKalb). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1242-1246(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

A Moessbauer study of $HoFe_2$, $ErFe_2$ and $TbFe_2$ between 300°K and $T > T_c$ (T_c – magnetic ordering temperature) has been undertaken. In $ErFe_2$ the direction of the magnetic hyperfine field is found to change from [111] towards [110] in the region of the magnetic compensation point (490°K). In all these compounds, quadrupolar coupling and s-electron density change abruptly at the magnetic ordering temperature. In $TbFe_2$ the Debye-Waller factor also appears to change abruptly at T_c. Above T_c the Karyagin–Goldanskii effect is observed, which indicates that the Debye-Waller factor is anisotropic. (auth)

19333 ANISOTROPY ENERGY MEASUREMENTS ON SINGLE CRYSTAL $Tb_{0.15}Ho_{0.85}Fe_2$. Williams, C. M.; Koon, N. C. (Naval Research Lab., Washington, DC). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1247(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

The temperature dependence of the magneto-crystalline anisotropy energy constants, K_1 and K_2, has been examined at various temperatures between 33 and 338°K for a $Tb_{.15}Ho_{.85}Fe_2$ single crystal sphere using torque magnetometry techniques. The results show that K_1 and K_2 are very sensitive to temperature in this range, and that K_2 is much larger than K_1. At room temperature K_2 has a value of 1.1×10^6 ergs/cm³ and K_1 has a value of -2.19×10^5 ergs/cm³ which is a factor of 265 and 87 less than the values predicted for the binary compounds $TbFe_2$ and $HoFe_2$, respectively. (auth)

19334 MAGNETIC PROPERTIES OF $R_2Fe_{17-x}M_x$ (R = Y, Tm, Ho AND M = Ni, Al) AND $Y_{2-x}Th_xFe_{17}$ COMPOUNDS. Narasimhan, K. S. V. L.; Wallace, W. E. (Univ. of Pittsburgh). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1248-1252(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

The effects of varying electron concentration on the magnetic ordering of R_2Fe_{17} compounds have been investigated in the temperature range 4.2°K to above the Curie temperature (T_c). T_c increases sharply and reaches a maximum of 610°K in the $R_2Fe_{17-x}Ni$ ternaries and 432°K in the $R_2Fe_{17-x}Al_x$ ternaries. $Y_{2-x}Th_xFe_{17}$ ternaries do not show an increase in T_c. Saturation moments measured at 4.2°K show a small increase for the thorium and nickel substituted ternaries, whereas Al substituted ternaries decrease in moment. Tm_2Fe_{17} and the Ni and Al ternaries show an unusual thermal magnetization behavior with peaks interpreted as magnetic structure transformation and anisotropy effects. The results are discussed in terms of site preference and distance dependence of magnetic interactions. (auth)

19335 MAGNETOSTRICTION OF Dy_2Co_{17}, Y_2Co_{17}, AND $Dy_xY_{2-x}Co_{17}$ INTERMETALLICS. Miller, A. E.; D'Silva, T.; Igarashi, H. (Univ. of Notre Dame, IN). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1253-1257(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

λ^γ and λ^ϵ have been measured on a series of partially substituted $Dy_xY_{2-x}Co_{17}$ single crystals between 77 and 600°K in fields up to 16 kOe. The magnetostriction has been analyzed according to the single ion model. (auth)

19336 MAGNETIC ANISOTROPY OF THE HEAVY RARE EARTHS. Brooks, M. S. S. (Polytechnic, Portsmouth, Eng.); Egami, T. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1258-1262(1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

A theory of the temperature and field dependence of highly anisotropic ferromagnets has been specialized to the hcp rare earths. Since the symmetry about the magnetization axis is non-cylindrical the anisotropy and magnetostriction constants are reduced below their saturated values by as much as 30% at zero temperature by zero point motion. A large low temperature field dependence of the planar anisotropy in Dy is predicted and detailed numerical analysis shows that the anisotropy constants measured in neutron inelastic scattering and static torque measurements may differ by up to a factor of two at low temperatures–depending upon the difference in the magnitude of the magnon energy gap for hard and easy directions. This provides a possible explanation for the anomaly in the size of the energy gap measured by Nicklow and Wakabayashi. (auth)

19337 MAGNETOELASTIC EFFECTS IN ERBIUM. Hubbell, W. C.; Salama, K.; Melcher, C. L.; Donoho, P. L. (Rice Univ., Houston, TX). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 18, 1263-1267 (1974).

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973). See CONF-731104-P2.

Magnetoelastic interactions in the rare-earth elements produce a number of effects in the propagation of ultrasonic elastic waves in these materials. Two of these effects are reported. The magnetoelastic interactions lead to striking anomalies in the temperature dependence of the elastic constants and for the propagation of shear waves along certain directions, the magnetoelastic interactions give rise to both linear and circular birefringence. The behavior of the elastic constant c_{33} in single-crystal erbium at temperatures below the Néel point was investigated both with no applied field and in fields up to 50 kG. In addition to several anomalies with no applied field, it was found that a field of 50 kG produced changes of as much as 9% in the value of c_{33}. In addition, the circular magnetoacoustic birefringence of shear waves propagating along the c-axis was observed. Measurement of this effect permitted an estimate of the single-ion coupling constant B^c in rough agreement with the other constants which have been determined from magnetostriction measurements. (auth)

19338 RELEVANCE OF TRADITIONAL MATERIALS SPECIFICATIONS TO POWDER METAL PRODUCTS. Brown, G. T.; Smith, T. B. (Group Technological Centre, Wolverhampton, Eng.). pp 9-31 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P7.

Wrought steel specifications are almost invariably written in terms of mechanical properties obtained by testing specimens, the axes of which are parallel to the rolling direction. It has long been appreciated that transverse properties, particularly ductility, are not necessarily as good. Experimental results are presented which show, in the specific case of manganese-molybdenum steel, that the difference is very considerable. Strength, fatigue, and impact properties are considered and explanations of the adverse behavior given. Using powdered materials it is possible to produce components which have uniform properties in all directions of stressing. The properties of powder forged steels tend to come mid-way between the anisotropic extremes encountered from wrought steel. The information necessary to ensure adequate service performance of engineering components is discussed and related to mechanical properties obtained with, particularly, powder forged materials although similar circumstances exist for sintered parts. The influence of non-metallic inclusion content on both wrought and powder forged steels is shown to be critical. While specifications written for wrought materials should primarily be used for quality control, it is possible to use equivalent data for powder fabricated materials as a true basis for design. (auth)

19339 FRACTURE TOUGHNESS EVALUATION OF POWDER-FORGED PARTS. Pilliar, R. M.; Bratina, W. J.; McGrath, J. T. (Ontario Research Foundation, Sheridan Park). pp 51-72 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P7.

A comparison of mechanical properties of powder-forged and wrought low-alloy, high-strength steels was made. Plane-strain fracture toughness values (K_{Ic}) were determined for two powder-forged, high strength, low alloy steels. The importance of nonmetallic inclusions on particle bonding and fracture toughness for powder-forged, high strength steels was demonstrated. The extent and nature of these nonmetallic inclusions depends on the alloy powder system. For powder-forged materials containing detrimental nonmetallic inclusions, improvements in K_{Ic} can be achieved by mechanical working and/or diffusion anneals of the full density alloy. Corresponding improvements in impact resistance and tensile ductility occur. Reliable correlation between K_{Ic} and Charpy impact values for the powder-forged and wrought steels was not found. Reduced oxygen levels, either in solution or as oxide phases, resulted in better fracture toughness values for the steels investigated. (JRD)

19340 INFLUENCE OF PROCESS VARIABLES ON PROPERTIES OF MOD. 8600 AND MANGANESE-NICKEL-MOLYBDENUM LOW ALLOY HOT FORMED P/M STEELS. Morcarski, S. (Ford Motor Co., Detroit). pp 303-321 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P7.

Properties of Ford MDO-101 (.35% Mn, .45% Ni, .6% Mo) and Mod. 8600 (.18% Mn, .45% Ni, .4% Mo) P/M steels were determined using different sintering atmospheres and temperatures, with and without lateral flow. It is concluded that hardenability of a given hot formed P/M steel can vary considerably as a result of residual oxygen; hardenability decreases as oxygen increases. In addition, high oxygen content can adversely affect ductility and impact strength. High temperature sintering at 2200 to 2250°F in low oxygen potential atmosphere results in excellent overall mechanical properties and provides maximum hardenability. Also, high temperature sintering of some alloys reduces the amount of lateral flow needed to obtain the desired impact strength. The chromium oxide in Mod. 8600 P/M preforms and some manganese oxide in MDO-101 apparently are reduced at temperatures of 2250°F to chromium or manganese in solution which thereby increases hardenability. If the highest levels of tensile properties and impact strength are desired, high temperature sintering might be economically justified. Where parts are used for applications not requiring high impact strength, P/M preforms hot formed without any sintering could probably provide adequate service performance. (auth)

19341 FORMABILITY OF LOW ALLOY AND PLAIN CARBON STEEL P/M PREFORMS. Stockl, P. L.; Antes, H. W. (Hoeganaes Corp., Riverton, NJ). pp 359-383 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P7.

A torsion test apparatus was assembled for testing powder preforms at elevated temperatures to assess the formability of these materials. Specimens were compacted from atomized powders and sintered at 2050°F in dissociated NH_3 to provide preform densities of 6.2, 6.7, and 7.2 g/cm^3. Specimens were heated rapidly with a quartz lamp furnace to forming temperatures ranging from 1400 to 2000°F. The specimens were soaked at temperature for 3 minutes and then twisted to failure. Argon was used as a protective atmosphere for all tests. The materials tested included atomized iron with sufficient graphite added to yield a 0.40% combined carbon. Two Ni-Mo low alloy steels (0.5 Ni-0.6 Mo and 1.8 Ni-0.5 Mo) were tested with 0.2, 0.4, and 0.6% carbon. Additional tests were run with the plain carbon steel preforms at 1500, 1600, and 1800°F to determine if exposure of preforms to the oxidizing conditions of air would affect the formability. Exposure times of up to 180 s were used. The results of the study indicated that preform formability increases as preform density and forming temperature are increased. The plain carbon steels exhibited better formability than the low alloy (Ni-Mo) steels. At the higher forming temperatures the low alloy steel with the higher nickel content had better formability than the one with the lower nickel content. It was also found that for the alloy steels formability increased slightly as the carbon content was increased. The adverse affect of forming at low temperatures (owing to the presence of ferrite and austenite) was demonstrated. The weaker ferrite deforms preferentially to the stronger austenite. Therefore, if more homogeneous deformation is to be achieved forming should be carried out on a single phase material. The results of the exposure work showed that virtually all of the decrease in formability and strength that is caused by oxidation of the preform occurs within the first 30 s. (auth)

19342 HOT FORGING OF PURE AND COATED BERYLLIUM POWDERS. Hirschvogel, M.; Aldinger, F. (Max-Planck-Institut fuer Metallforschung, Stuttgart). pp 441-455 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P7.

The forging behavior of Be is compared with that of Be-Ag alloys made from Ag-coated powders. Investigation results show the feasibility of free forging beryllium and silver-coated beryllium powder preforms. The suitable temperature range is 640 to 900°C. The critical forging ratio at which the preforms start to burst increases with increasing forging temperature and increasing initial density. Increasing length/dia values have the opposite effect. These relations can be used as a guide in selecting the proper preform. For oxidation prevention an argon atmosphere or coatings of glass or steel can be used whereby the coatings additionally offer protection against beryllium contamination. Particularly useful are glass coatings since they provide good lubrication in addition to oxidation protection. Usually the forgings require less finishing when

glass coatings are used. That even relatively complex shapes can be produced by the described method was demonstrated by forging a differential pinion gear. Also it can be said that the sinter forging of brittle powders coated with a ductile matrix metal is a feasible method to produce fully dense composites with controlled structure. (auth)

19343 PREPARATION AND PROPERTIES OF P/M COPPER–BERYLLIUM ALLOYS. Dreizler, W.; Aldinger, F.; Exner, H. E. (Max Planck Institut fuer Metallforschung, Stuttgart). pp 505-517 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From fourth international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P7.

The sintering properties of Cu–Be alloys were studied. It was found that unfavorable sintering behavior of prealloyed copper-beryllium powders is due to the formation of a diffusion barrier consisting of beryllium oxide. Sintering can only be carried out if the oxide present on the particle surface after powder production and storage is removed and reoxidation is avoided during the entire handling and sintering process. Leaching seems to be the most effective and simplest way to remove the oxide. However, an oxygen free atmosphere is hardly feasible in industrial practice. Therefore, additional developments are necessary before the economic advantages of powder metallurgy production of copper-beryllium alloys can be exploited in industry. It appears that there are several possibilities. One way would be hot forging of canned precompacts of leached powders for materials with properties comparable to cast alloys. Another possibility is cold pressing and sintering of leached powders with additions preventing oxidation. A similar development was successful in aluminum powder metallurgy where surface protection by lubrication and metallic additions have proven effective. It is hoped that similar progress can be realized in the field of copper-beryllium powder metallurgy as well. (auth)

19344 PRECIPITATION HARDENING SINTERED COPPER-BASE ALLOYS. Fetz, E.; Hollingbery, D. R.; Cavanagh, R. L. (Ontario Research Foundation, Sheridan Park). pp 537-583 of Modern Developments in Powder Metallurgy. Vol. 7. Hausner, H. H. (ed.). Princeton, NJ; Metal Powder Industries Federation (1974).

From 4th international conference on powder metallurgy; Toronto, Canada (15 Jul 1973). See CONF-730718-P7.

The Cu–Co–Be and Cu–Ni–Sn systems, which yield exceptionally high precipitation hardnesses in melted copper alloys, were employed to elucidate the P/M alternatives in powder production and sintered parts manufacture. The three powder routes open to the fabricator, namely the use of fully prealloyed, partially prealloyed, and of blends of elemental powders are investigated in depth with sintered nickel bronzes. The latter were also employed to explore the possibilities of (a) cost reductions by suitable substitutions for high-priced, stoichiometrically unfavorable alloying elements and (b) attainment of higher strength levels through superimposition of cold work hardening and age hardening. The significant effects of the atomizing technique, i.e. gaseous versus water, upon Cu–Co–Be powder and thus on green and sintered compacts were investigated. The neutralization or elimination of the undesirable consequences of surface coatings and films formed on fully prealloyed beryllium–copper powder atomized for economic reasons in a non-protective atmosphere received special attention. The basic P/M problem of loss of strength due to residual porosity was also explored with sintered beryllium–copper whereby preference was accorded to processing techniques readily adaptable to the P/M industry. Criteria of practicality and economics are not only applied to powder production and sintered part manufacture of age-hardenable Cu-base alloys, but also in a critical assessment of experimental techniques and of testing methods for powders, and green and sintered compacts. Conclusions drawn are largely based on evidence obtained by optical and electron microscopy, chemical and electron microprobe analyses, and diametral compressive (indirect tensile strength) determinations. Indentation hardness tests were used to establish precipitation hardening kinetics. The future of sintered Cu-base alloys for sintered parts manufacture is considered to be ultimately linked to a substantial improvement in the strength-weight-price ratio. (auth)

19345 STRUCTURE AND STABILITY OF $SmCo_5$. Khan, Y.; Qureshi, A. H. IEEE (Inst. Elec. Electron. Eng.), Trans. Magnet.; MAG-9: No. 3, 156-158(Sep 1973).

The structure of $SmCo_5$ has been investigated between 500°C and its melting point. It is found that $SmCo_5$ is a composite of two phases. One of them is unstable and decomposes below 1150°C, giving rise to the neighboring phase Sm_2Co_{17}. No traces of Sm_2Co_7 have been observed during this decomposition. The reaction of $SmCo_5$ with the container materials is discussed. (Metals Abstr.)

19346 THERMAL CONDUCTIVITY OF RHENIUM. Peletskii, V. E.; Sobol, Ya. G.; Amasovich, E. S. (Moscow Inst. of High Temperature). High Temp.–High Pressures; 5: No. 1, 9-12(1973).

From 3rd European conference on thermophysical properties; Turin, Italy (20 Jun 1972).

The electrical and thermal conductivities of Re were measured at 1200 to 2400°K. The thermal conductivity was measured on an 8-mm-dia, 70-mm long specimen using a modified longitudinal heat flow method and electron bombardment. Results are compared with literature data. Temperature variation of the Lorenz number for rhenium and the mechanism of conduction are discussed. (auth)

19347 DEVELOPMENT OF ORDERED MICROSTRUCTURES BY ELASTIC INTERACTION. Giraud-Heraud, F. (Societe Industrielle de Combustible Nucleaire, Veurey, France). Mem. Sci. Rev. Met.; 71: No. 1, 37-50(Jan 1974). (In French).

Complex decomposition phenomena were observed in certain alloys. Electron microscopic studies of thin-foil samples revealed the presence of fine striations. An attempt was made to establish the origin of these striations. The formation of tweed structures in 2% Be–Cu alloys was studied together with the formation of tweed structures by continuous ordering or spinodal decomposition, ω transition characterization, and the formation of tweed structures in U–Nb–Zr alloys. (FR)

19348 DIAGRAM OF STATE OF THE TUNGSTEN–SILICON SYSTEM. Kocherzhinskii, Yu. A.; Kulik, O. G.; Shishkin, E. A.; Yupko, L. M. (Inst. of Metal Physics, Kiev). Dokl. Chem.; 212: No. 1-3, 782-784(Sep 1973).

Translated from Dokl. Akad. Nauk SSSR; 212: No. 3, 642-643 (Sep 1973).

From experimental results (DTA, x ray, microstructure, hardness), the phase diagram was plotted for temperatures from 1000 to 2500°C over the entire composition range. The WSi_2 mp is 2020 ± 20°C, W_5Si_3 melts congruently at 2095 ± 20°C, a $WSi_2 + W_5Si_3$ eutectic (53 at. % Si) is at 1940 ± 20°C, and a α-W + W_5Si_3 eutectic is at 2085 ± 20°C with 32 at. % Si. The solubility of Si in W is 2.35 at. % Si at 2000°C and 0.97 at. % Si at 1750°C. (DLC)

19349 EFFECT OF SUBSTITUTION OF TUNGSTEN FOR MOLYBDENUM IN TWO CAST COBALT-BASE SUPERALLOYS. Morrow, H. III; Danesi, W. P.; Sponseller, D. L. (Climax Molybdenum Co. of Michigan, Ann Arbor (USA)). Kobalt; No. 4, 82-89(1973). (In German).

7 figs.; 5 tabs.; 3 refs.

The effect of the substitution of tungsten for molybdenum in two commercial cobalt-base superalloys has been investigated in order to show that the addition of molybdenum to these alloys may be of advantage. Furthermore, the two alloys have been studied with regard to the advantages to be achieved by substituting the 10% of nickel, usually contained in these alloys to stabilize the fcc mixed cobalt crystal and to improve ductility economically using the same amount of iron. (GE)

19350 LONGITUDINAL RESIDUAL STRESSES IN BORON FILAMENTS. Faughnan, K. A. (Naval Material Command, Dahlgren, VA). pp 4.B.1-4.B.10 of Wide World of Reinforced Plastics. New York; Society of the Plastics Industry, Inc. (1974).

From twenty-ninth annual conference of the Society of the Plastics Industry; Washington, DC (5 Feb 1974).

Longitudinal residual stresses in boron–carbon and boron–tungsten filaments were examined by x-ray analysis, length change measurements, and curvature change measurements. Results agree with a proposed stress model involving phase changes, differences in thermal expansion coefficients, and aspects of the vapor deposition process. Length and curvature change measurements both indicate large surface compressive stresses on the order of 250,000 psi in both filaments. Changes in production speeds of the boron filaments appear to have little influence on stress directions and magnitudes, and no structural bonding was observed between the boron sheath and the carbon core. (IAA)

19351 PHASE ANALYSIS OF LIQUID-PHASE SINTERED Co_5Sm MAGNET COMPACTS. Smeggil, J. G. IEEE (Inst. Elec. Electron. Eng.), Trans. Magnet.; MAG-9: No. 3, 158-160(Sep 1973).

The phases present in liquid-phase sintered Co_5Sm magnets were determined. Specimens sintered at 1100°C and given subsequent thermal treatments were examined by optical metallography, electron microprobe, and x-ray diffraction techniques. The results suggest that these materials do not exhibit an equilibrium configuration of phases. (Metals Abstr.)

19352 CONDUCTION ELECTRON POLARIZATION; SPIN DENSITIES AND THE NEUTRON MAGNETIC FORM FACTOR OF GADOLINIUM. Harmon, B. N. Evanston, IL; Northwestern University (1973). 106p. University Microfilms Order No. 74-7755.

Thesis (Ph. D.).

Conduction electron polarization, spin densities and neutron magnetic scattering in ferromagnetic Gd metal were studied using the spin polarized APW method. The spin up and spin down bands were found to be very similar in shape to the bands from a paramagnetic calculation, with the exchange splitting proportional to the amount of d character in the bands. It was also found that the conduction electron spin density determined from the APW wavefunctions is of mostly d character. This dominance of the d-like wavefunctions for the spin dependent interactions is explained by: (1) the much greater overlap of the 4f states with the d-like wavefunctions as compared to the s–p wavefunctions; (2) the nearly complete d character of the bands in the region of the Fermi surface. The magnetic form factor was calculated from the conduction electron spin density and compared with the recent neutron magnetic form factor measurement of Moon, Koehler, Cable, and Child. After including core polarization effects it has been concluded that large nonspherical contributions with $Y_{33}-Y_{3-3}$, and Y_{44} angular dependence are needed to explain the experimental results. The APW wavefunctions have been studied and found to be well converged, but sensitive to corrections of the muffin-tin potential. A self-consistent potential with nonmuffin-tin corrections would give improved agreement with experiment. (Diss. Abstr. Int., B)

19353 EVALUATION OF THE ELEVATED TEMPERATURE TENSILE AND CREEP-RUPTURE PROPERTIES OF 0.5Cr–0.5Mo, 1Cr–0.5Mo, AND 1.025Cr–0.5Mo–Si STEELS. Smith, G. V. ASTM Data Series Publication DS 50. New York; American Society for Testing and Materials (1973). 157p. $8.25.

The elevated temperature strength and ductility of three low Cr–Mo steels that find extensive services at temperatures up to 1100°F are evaluated. Included in the evaluations are previously unpublished test results gathered by the Metal Properties Council, as well as test results previously published in ASTM Data Series DS 6 (1953) and DS 6S1 (1966). Employing a normalization procedure that involves rationing the elevated temperature strength of a particular test lot to the room-temperature strength of the same lot, and applying the method of least squares, trend curves depicting the characteristic temperature variations of yield and tensile strengths have been developed. The rupture and secondary creep rate data have been evaluated by both direct isothermal interpolation or extrapolation, and by time-temperature parameter, to establish the dependencies of the average and minimum stresses to cause rupture in 1000, 10,000, and 100,000 h and of average and minimum stresses to cause secondary creep rates of 0.1 and 0.01%/1000 h. Elogation and reduction of area data are included for both the short-time tensile tests and the rupture tests. (Metals Abstr.)

19354 ELECTRON MICROSCOPE OBSERVATIONS ON PRECIPITATION IN A Cu–1.07% Zr ALLOY. Phillips, V. A. (Open Univ., Oxford). Metallography; 7: No. 2, 137-155(Apr 1974).

The nature of precipitation was studied in a strip of a high-purity Cu–1.07% Zr alloy, solution treated at 950°C. Stacking faults were generated during aging at 500°C, associated with bands of fine-precipitate platelets, and tended to disappear at long aging time. The mechanism of generation of these faults is discussed. No faults were observed if the alloy was cold-rolled 40% prior to aging at 500°C. Instead, very fine-precipitate platelets formed at dislocations and recrystallization was absent even after 48 h aging. Partial recrystallization occurred on aging 1 h at 650°C, complete after 5 min at 750 or 850°C. The precipitate platelets were parallel to {111} matrix planes and showed no evidence of coherency strain fields. They were thought to be the Cu_5Zr equilibrium phase. X-Ray d-values were obtained on particles extracted from a hot-rolled Cu–10.2% Zr alloy. (6 figures) (auth)

19355 STRESS INDUCED MARTENSITIC TRANSFORMATION IN COBALT–30% TUNGSTEN. Nygren, R. E. Evanston, IL; Northwestern University (1973). 327p. University Microfilms Order No. 74-7792.

Thesis (Ph. D.).

Martensitic transformation (fcc → hcp) occurs during tensile testing of metastable fcc Co–0.30(wt fraction)W. At test temperatures ranging from –196 to 320°C, sheet specimens were subjected to various amounts of tensile strain and then x-rayed to determine the volume fraction of martensite present. The surface deformation morphology of the strained samples was observed using optical and scanning electron microscopes. A phenomenological model of stress-dependent growth of the martensite platelets was formulated using a dislocation model of the edge of a disk shaped platelet. Using this model the range of thicknesses of martensite platelets expected in the samples was estimated. Also, theoretical curves of volume fraction hcp phase vs. strain and stress vs. strain were calculated with this model. These curves agreed well with the empirically determined data. Other topics discussed in the dissertation include fracture behavior, the strain contributions from slip and transformation (considered as simultaneous deformation mechanisms), surface deformation morphology, the crystallography of twin formation of the intersection of hcp transformation (martensite) platelets, and a method of exactly computing the true-stress vs. true-strain curve from the load-elongation data and the sample geometry. (Diss. Abstr. Int., B)

19356 HOW NEW SPECIALTY METALS TECHNOLOGY BENEFITS USERS. Metal Progr.; 106: No. 3, 39-41; 44-46; 51-52(Aug 1974).

Advanced metallurgical processes such as vacuum induction melting, vacuum arc remelting (VAR), argon–oxygen decarburization, and electroslag remelting, produce alloys with tightly controlled composition and properties. Case histories of how these and other processes contribute to user economies are given; the materials discussed include Ni–Cr–Mo superalloys (Hastelloy C and C-276), stainless steels (26 Cr–1Mo; ferritic, etc.), high-performance bearing steels, superalloys, maraging steels, carbides, etc. (28 references) (DLC)

19357 METALLOGRAPHIC PREPARATION OF BORON CARBIDE. Martel, Y.; Drolet, J. P. (Defence Research Establishment, Valcartier, Quebec). Metallography; 7: No. 2, 161-164(Apr 1974).

The method described shortens the time required for polishing and etching hot-pressed boron carbide. The samples are mounted in thermoset plastic, automatically ground on Al-backed diamond discs, and electropolished in 1% KOH. Microstructures free from artifacts can be obtained; examples are given of boron carbide hot pressed at 2000°C. (DLC)

19358 DEFORMATION BEHAVIOR OF AGE-HARDENED Ti–Mo ALLOYS. Gysler, A. (Univ. of Stuttgart); Luetjering, G.; Gerold, V. Acta Met.; 22: No. 7, 901-909(Jul 1974).

The tensile properties of Ti–Mo alloys hardened by the precipitation of ω-particles were correlated to the microscopic deformation behavior. The reduction in macroscopic ductility with increasing precipitation of ω-particles could be explained by the fact that the moving dislocations were able to shear the hard ω-particles leading to an extreme inhomogeneous slip distribution. Cracks were initiated by slip bands intersecting with each other and with grain boundaries. Depending on the degree of inhomogeneous slip cracks propagated through the matrix, along grain boundaries or along slip bands. The various morphologies of the fracture surfaces were correlated to these micromechanisms. On a microscopic scale all specimens showed a ductile, dimple type of fracture surface even if the specimens failed without any macroscopic ductility. (auth)

19359 PRESSURE-VESSEL STEELS: PROMISE AND PROBLEM. Gross, J. H. (U. S. Steel Crop., Monroeville, PA). Metals Eng. Quart.; 14: No. 3, 36-41(Aug 1974).

During the past 25 years, numerous pressure-vessel problems have been solved, but in many instances the solutions have led to other problems. Currently, promising developments in pressure-vessel steels are providing such solutions and such additional problems with respect to fabrication and various failure modes. With respect to fabrication, lamellar tearing is being minimized by special melting and solidification practices. However, continuous casting and electroslag-remelting of slabs are currently limited in plate size that can be produced. With respect to bursting, results of recent studies indicate that high-yield-strength steels have higher burst-strength indices than lower-strength steels even for vessels with nozzles and notches up to 25% of the wall thickness. Strength, and therefore resistance to bursting, can be increased without loss in toughness through new control-rolling practices, except that these practices are limited to plates up to 3/4 in. thick. New high-toughness line-pipe steels are now available that should be very attractive for pressure vessels that require very high resistance to shear tearing. These low-sulfur steels may be somewhat impaired by sensitivity to splitting as a result of the control-rolling practice. To date, steels have not been developed with improved resistance to fatigue failure. Fortunately, pressure vessels have rarely failed by fatigue. Similarly, resistance to failure by environmental effects is not basically improved by changing steel composition, usually because of difficulty in defining the effects of the numerous environments that may be involved. (auth)

19360 FATIGUE AND CRACK PROPAGATION BEHAVIOR IN Ti–6Al–6V–2Sn. Amateau, M. F.; Kendall, E. G. (Aerospace Corp., El Segundo, CA). Metals Eng. Quart.; 14: No. 3, 59-61(Aug 1974).

The fatigue properties of this alloy in various forms and under various conditions are presented graphically and discussed. Data and information are included on fatigue strength and fatigue crack growth. (JRD)

19361 FERRITE IN AUSTENITIC STAINLESS STEEL WELD METAL. Delong, W. T. (Teledyne McKay, York, PA). Weld. J. (N. Y.); 53: No. 7, 273s-286s(Jul 1974).

From fifty-fifth AWS annual meeting; Houston, TX (6 May 1974).

The measurement, control, nature, and role of ferrite in stainless steel weld metal are examined. Information is included on properties of ferrite, analysis of ferrite content, fissuring of weld metals, and research on ferrite. (JRD)

19362 ANISOTROPY OF LOW-TEMPERATURE PLASTICITY AND THE DEFORMED MOLYBDENUM TENDENCY TO STRATIFICATION. Ivashchenko, R. K.; Milman, Yu. V.; Trefilov, V. I.; Khomenko, G. E. (Inst. of Metal Physics, Kiev). Probl. Prochnosti; No. 7, 64-67(Jul 1973). (In Russian).

Changes in low-temperature plasticity and structural and substructural properties of low-alloyed Mo were studied as a function of rolling temperature from 500 to 1000°C. Anisotropy of the temperature of transition to brittle fracture for longitudinal and cross-sectional samples was expressed by the tendency of the deformed metal to stratify. (tr-auth)

19363 INVESTIGATION OF THE WEAKENING PROCESSES IN MOLYBDENUM AND ITS ALLOYS FOLLOWING CREEP. Marushi, O. I.; Zasimchuk, E. E. (Inst. of Problems in Materials Science, Kiev). Probl. Prochnosti; No. 8, 34-37(Aug 1973). (In Russian).

Structural changes due to creep in Mo and its alloys with Ti and Zr which were annealed before testing at temperatures above 1200°C were studied. The deformation rate (onset of third stage of creep) was shown to be related to recrystallization in local regions of the material. Deformation is stimulated by creep and is not related to the initial structure of Mo or the alloys. The mechanism of the forming of the recrystallization zone in the material with development of the substructure is examined. (tr-auth)

19364 COLD RESISTANCE OF LOW-CARBON STEEL WITH RARE EARTH METALS. Butko, N. I.; Navrotskii, I. V.; Sokol'skii, Yu. Z. (Ukrainian Scientific-Research Inst. of Metals, Kharkov). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 11-12, 929-932(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 11, 6-9(Nov 1973).

The impact strength and the ductile-brittle transition temperature T_k were measured for hot-rolled low-C steel St2sp containing different amounts of rare earth metals (Si–La or Si–misch metal). The relationship between the amount of oxygen in solid solution and T_k was investigated. Deformation around nonmetallic inclusions and the relaxation were studied; the internal friction was also measured. It is concluded that rare earth additions lowers the T_k owing to reduction of the impurity content at dislocations. (DLC)

19365 EFFECT OF RETAINED AUSTENITE ON THE IMPACT-FATIGUE STRENGTH OF STEEL. Kozyrev, G. V.; Toporov, G. V. (Tomsk Engineering-Architectural Inst., USSR). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 11-12, 1064-1066(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 12, 45-48(Dec 1973).

The effect of retained austenite on the impact-fatigue strength of steel Kh12M (1.48 C, 11.5 Cr, 0.3 Mn, 0.3 Si, 0.2 V, 0.45 Mo) depends on the acting stresses. At a high stress level, when machine parts have a short service life, retained austenite increases the impact-fatigue resistance, but decreases it at low stresses. There are also intermediate stresses at which the amount of retained austenite has no effect on the impact-fatigue resistance of a material within a broad range. The optimal amount of retained austenite to ensure high resistance to impact-fatigue must be selected in view of the specific operating conditions of machine parts (given service life and possibility of overloading). (auth)

19366 PROPERTIES OF HIGH-STRENGTH CLADDED PLATE IN TENSION. Pashkov, P. O.; Yavor, A. A.; Savchenkov, E. A.; Kotov, N. V.; Sklyarov, N. M.; Mikheev, A. A.; Platonov, A. A. (Volograd Polytechnical Inst., USSR). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 11-12, 1056-1058(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 12, 37-40(Dec 1973).

The strength of cladded steel VKS-1 (1.6% Cr–0.8% Mn–0.95% Si–0.4% Mo) in biaxial tension reaches values 20-25% higher than that of the homogeneous steel. For cladded high-strength steel, the use of electroslag remelting increases the ductility, but to a lesser extent than for the homogeneous steel. (auth)

19367 INCREASING THE TOUGHNESS AND DUCTILITY OF STEEL 000Kh11N10M2T IN LARGE SECTIONS. Kagan, E. S.; Smirnov, B. S.; Fridman, V. S. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 15: No. 11-12, 1033-1036(1973).

Translated from Metalloved. Term. Obrab. Metal.; 15: No. 12, 13-17(Dec 1973).

Hot rolled rings manufactured by the full cycle consisting of water quenching from 1200°C, rolling at 1050°, hardening from 860°, and aging at 500-525° have a high ductility and toughness in the tangential direction and satisfactory properties in the axial directions. The ductility and toughness of rings manufactured by the shortened cycle without preliminary quenching from 1200° differ little from those of rings quenched from 1200°. However, the fractures of impact test samples have a distinct texture, and therefore the equivalence of these treatments can be confirmed only by additional studies of larger sections. The ductility and toughness of hot-rolled rings can be increased by heat treatment to an ultimate strength σ_b = 120–130 kg/mm², which permits austenite to be retained in the structure: 600° for 2 h or 600° for 5 h + 500° for 2 h. It was found that the ductility and toughness of steel 000Kh11N10M2T can be increased by heat treatment to an ultimate strength σ_b = 135–150 kg/mm², including aging at 600°, hardening from 860°, and aging at 500°. (auth)

19368 SOFTENING OF METALLIC COMPOUNDS AND THE PROPERTIES OF ALLOYS IN THE ALUMINUM–COPPER–YTTRIUM SYSTEM. Drits, M. E.; Kadaner, E. S.; Nguen Din Shoa. pp 167-170 of Khimiya Metal. Splavov. Moscow; Izdatel'stvo Nauka (1973). (In Russian).

Measurements of microhardness were used to study the softening of the compounds YCu_4Al_8 (Ψ), $YCu_{0.5}Al_{3.5}$ (D), and YAl_3 which are present in Al-rich alloys of the Al–Cu–Y system at temperatures above 250°C. The Ψ phase has the highest microhardness and is only slightly softened by heating whereas the D phase which has high values at room temperature is markedly softened by increase in temperature and with time. The YAl_3 phase has lower values than the ternary phases and is significantly softened at 150°C although it is little changed above this temperature. Definite relationships were established between the properties of these phases and those of the alloys in which they occur. (Ref. Zh.)

19369 HUGONIOT EQUATION OF STATE OF BERYLLIUM OXIDE. Marsh, S. P. (Los Alamos Scientific Lab., NM). High Temp. – High Pressures; 5: No. 5, 503-508(1973).

The Hugoniot equation of state of crystal-density beryllium oxide has been calculated from Hugoniot data obtained on porous beryllium oxide materials of density 3.0, 2.8, and 2.5 g cm^{-3}. Bulk sound velocity, $[V^2(\partial P/\partial V)_s]^{1/2}$, was obtained by extrapolating longitudinal and transverse sound velocities to zero porosity. The resulting Hugoniot equation of state, on assuming a constant value for $\rho\gamma$ of 3.77 g cm^{-3}, is $u_s = 8.576 + 1.208u_p$ [km s^{-1}]. (auth)

19370 Hf–Cu PHASE DIAGRAM. Markiv, V. Ya.; Pet'kov, V. V.; Storozhenko, A. I.; Ivanchenko, V. G.; Gorskii, V. V. Izv. Akad. Nauk SSSR, Metal.; No. 2, 209-213(1974). (In Russian).

Phase diagrams were constructed for Hf–Cu which are characterized by the presence of four compounds: Hf_2Cu, Hf_2Cu_3, Hf_2Cu_5, and $HfCu_3$. Three of these (Hf_2Cu, Hf_2Cu_3, and $HfCu_3$) are formed from melts; Hf_2Cu_5 from a peritectic reaction. Hf_2Cu, Hf_2Cu_3, and Hf_2Cu_5 are isostructured compounds corresponding to components of the Zr–Cu system. (tr-auth)

19371 Mo ANGLE IN THE TERNARY SYSTEM Mo–V–C. Kiseleva, V. N.; Zakharov, A. M.; Yudkovskii, S. I. Izv. Akad. Nauk SSSR, Metal.; No. 2, 214-216(1974). (In Russian).

Metallographic, x-ray, and electronographic analysis, temperature measurements at the beginning of melting, and hardness measurements were used to study the Mo angle in the Mo–V–C system (up to 0.5% C and 1.2% V). Isothermal sections were constructed at 2100, 1600, and 1200°C and a polythermic section of Mo–V_2C. V decreased the solubility of C in solid Mo; with >0.2% V, the solubility of C in Mo–V alloys did not increase at 2100°C; with 0.03 to 0.04%, at 1600°C; 0.02% at 1600°C; and 0.01%, at 1200°C. In all the alloys studied, at equilibrium with a Mo solid solution there was a (Mo, V)$_2$C phase (or a solution of V in Mo_2C). With solution of V, the lattice periods of Mo_2C decreased. The polythermal section of Mo–V_2C in the ternary system Mo–V–C is not quasi-binary and does not coincide with

the direction of the tie-line in a two-phase volume, α + (Mo, V)$_2$C. The maximum common solubility of V and C in Mo in this section at 2250°C is ~0.24% (0.18% V and 0.06% C), it sharply decreases with decrease in temperature. (tr-auth)

19372 CONSTRUCTION OF MELT DIAGRAMS OF Ti–V–Nb–Mo SYSTEMS BY THE SIMPLEX LATTICE METHOD. Sobolev, N. N.; Levanov, V. I.; Elyutin, O. P.; Mikheev, V. S. Izv. Akad. Nauk SSSR, Metal.; No. 2, 217-221(1974). (In Russian).

Thirty-five mathematical models were constructed for the solidus volume of the Ti–V–Nb–Mo system, using the simplex lattice method. From these, precise calculations were made of the solidus temperature of alloys of any composition of the system and confirmed by comparison of experimental and calculated solidus temperatures for 10 control alloys. Solidus surfaces were constructed (on the computers) for the Ti–V–Nb, Ti–V–Mo, Ti–Nb–Mo, and V–Nb–Mo systems and for a number of quaternary systems with constant Ti contents. The method is considered promising for constructing such diagrams. (tr-auth)

19373 EFFECT OF Zr ON THE GROWTH RATE AND MICROHARDNESS OF A BORIDED LAYER ON IRON. Belyaeva, V. P.; Loskutov, V. F.; Permyakov, V. G.; Pisarenko, V. N.; Trush, I. Kh. Izv. Akad. Nauk SSSR, Metal.; No. 2, 222-223 (1974). (In Russian).

Increasing the Zr content in Fe decreased the depth of the borided layer under different saturation conditions. The Zr dissolved in FeB and FeB$_2$, with an increase in hardness. Diffusion properties of B in austenite Fe–Zr alloys were determined. No more than 0.5 wt % Zr should be included in alloy steels that are to be borided. (tr-auth)

19374 QUALITY OF AN INGOT OF FERRITE STEEL CONTAINING CERIUM AND NIOBIUM. Savitskii, E. M.; Popov, V. F.; Sapel'nikov, P. P.; Shmatko, M. N. Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 9, 46-49(1973). (In Russian).

The effect of additions of 0.07% ferrocerium and a complex of 0.07% ferrocerium and 0.05% ferroniobium on the structure and properties of ingots of the ferrite steel Kh25T of industrial smelting was studied. The microalloying was done by grinding of the bar crystals and increase of the zone with oriented crystallization. The O and H concentration was reduced 1.5 to 2 times. Surplus phases in the test metals were distributed along grain boundaries and in the matrix were more homogeneous than in the normal metal and acquired a rounded form. Metallographic studies of the grain boundaries showed that they are purer and thinner in metals with additions of ferrocerium and ferroniobium. Torsion tests and measurement of the specific viscosity in the interval from 950 to 1200°C showed that the greatest increase in ductility was observed in the central zone of the ingot and was ten-fold greater than the usual metals. (tr-auth)

19375 ELECTROMIGRATION OF HYDROGEN AND DEUTERIUM IN Ti AND Zr. Harold, A.; Mareche, J. C.; Rat, J. C. (Univ., Nancy). Compt. Rend., Ser. C; 278: No. 15, 1009-1010 (8 Apr 1974). (In French).

Hydrogen and deuterium dissolved in titanium and zirconium migrate under the effect of an electric current; the migration takes place in the same direction as the current. At 800°C, the migratory flow is proportional to the intensity of the current but not to the square root of the pressure. Solubility and resistivity measurements made on the same samples enabled electrical mobilities to be calculated and comparisons to be made with those deduced from the thermal diffusion coefficients. (FR)

19376 HEAT RESISTANCE OF Nb ALLOYS 5VMTs, 5VMTsU, AND 5VTTs AT A TEMPERATURE OF 1100°C. Tsvilyuk, I. S.; Pyl'nikov, V. I.; Men'shikh, V. A. (Inst. of Strength Problems, Kiev). Probl. Prochnosti; No. 11, 39-42(Nov 1973). (In Russian).

The aim is to establish the singularities of the resistivity of Nb alloys 5VMTs, 5VMTsU, and 5VTTs to prolonged deformation and destruction, and to show which has the higher heat resistance. Comparative results are presented on the long-term strength and creep of the alloys in a vacuum of 10^{-5} torr at 1100°C for 3000 hours. Results of gas analysis for oxygen content showed that essential saturation of the specimens with oxygen took place during the tests. The alloys 5VMTs and 5VMTsU have greater heat resistance than alloy 5VTTs, in spite of the fact that alloy 5VMTsU has a higher content of carbon and zirconium than does alloy 5VMTs. (JPRS)

19377 DEFORMATION OF NON-STOICHIOMETRIC ALLOYS BASED ON Cd_3Mg. Noble, F. W.; Fairhurst, W. (Univ. of Liverpool). Acta Met.; 22: No. 8, 985-990(Aug 1974).

The effect of deviation from stoichiometry on the strength of single crystals of alloys based on Cd_3Mg was studied, mainly at room temperature. Magnesium-deficient alloys (down to 17% Mg) exhibit two-phase structures and the observed strength of these alloys was interpreted in terms of the crystallographic relationship between the two phases present. Magnesium-rich alloys, on the other hand, retain the DO_{19} superlattice (at least up to 33% Mg), and critical resolved shear stress measurements for both basal and prismatic slip show an increase with increasing Mg content. Differences in the behavior of basal and prismatic slip were tentatively ascribed to whether or not slip is occurring by the movement of superlattice dislocations. (10 figures) (auth)

19378 ELECTRICAL RESISTANCE, ENTHALPY, AND PHASE TRANSITION IN Ti, Zr, AND Hf IN PULSED HEATING. Martynyuk, M. M.; Tsapkov, V. I. Izv. Akad. Nauk SSSR, Metal.; No. 2, 181-188(1974). (In Russian).

A continuous-pulse-heating method was used to measure the dependence of the specific electrical resistance ρ on enthalpy H for Ti, Zr, and Hf at temperatures above the melting point. ρ was determined for the α and β phases of these metals at the temperature of polymorphic transition and for the liquid phase at the melting point. The enthalpy was determined for the solid phases of the three metals and for the liquid phase at the melting point for Ti and Zr. The α-β heat of transition was measured for all three. With a heating rate of 10^7 deg/sec, α-Ti overheated at 90°C and α-Zr at 160°C above T$\alpha\beta$. Theoretical analysis of the ρ(H) and the kinetics of the α-β transition and of fusion at fast heating rates are reported. (tr-auth)

19379 PROPERTIES OF LOW-CARBON STEEL WITH V ADDITIVE AFTER CONTROLLED ROLLING. Matrosov, Yu. I.; Nasibov, A. G. Izv. Akad. Nauk SSSR, Metal.: No. 2, 159-166 (1974). (In Russian).

Decreasing the temperature at the end of rolling from 950 to 700°C resulted in an increase in the temporary resistance and the limit of the viscosity in low-C steels, especially after rolling with subsequent reduction at 700°C. Decreasing the temperature to 800°C had a favorable effect on the resistance of the steel to brittle disintegration, shifted to negative temperatures of the cold brittleness threshold, and evaluated from the type of fracture and impact strength. Decreasing the temperature to 700°C had an unfavorable effect, decreasing the absolute impact strength despite an increase in the grain particles in fractures of impact samples. Decreasing the rolling temperature from 1200-1250°C to 1050-1100°C increased the impact strength and decreased the toughness. Addition of 0.06% V increased the strength and toughness of low-C steels after all rolling regimes. The increase in temporary resistance with 0.01% V, heating to 1200-1250°C and end temperature of 800°C was 1.2 kg/mm^2, with a viscosity limit of around 1.6 kg/mm^2. The threshold of cold brittleness, T_{50}, of steel with 0.06% V, rolled under these conditions, was about –50°C, i.e., 20°C below that without V, and the impact strength at –40°C was ~1.5 kg-m/cm^2 higher. The mechanical properties of low-C steel containing 0.06% V after rolling at 1200-1250°C, end temperature 800°C, are given. (tr-auth)

19380 EFFECT OF RARE EARTH METALS ON Cr STRUCTURE AND PROPERTIES. Pakitskii, A. N.; Trefilov, V. I. Izv. Akad. Nauk SSSR, Metal.; No. 2, 153-158(1974). (In Russian).

Alloying of Cr with rare earths purified the matrix from N and decreased its dynamic deformation in aging. Cr plasticity was increased by addition of 0.2-0.7 wt % Ce subgroup elements, La being the most effective. Addition of 0.2-0.7% rare earths significantly decreased Cr hardness at room temperature and higher temperatures. Cast alloys containing Yb subgroup elements (except Y and Gd) showed increased creep but Cr hardness decreased somewhat when they were introduced. Increasing the rare earth content of Cr above the optimum impaired the plasticity of the cast metal owing to formation of another phase. (tr-auth)

19381 INFLUENCE OF THE COMPOSITION OF MAGNESIUM ALLOY OF THE Mg–Zn–Zr–RARE EARTHS SYSTEM ON THE TENDENCY TO HOT CRACK FORMATION. Ryazantsev, V. I.; Smirnova, E. I.; Osokina, T. N. Svar. Proizv.; No. 5, 28-30(May 1973). (In Russian).

Alloys of the system Mg–Zn–Zr–rare earths with concentrations of 1.0 to 1.6% Zn, 0.04 to 0.1% Zr, and 0.16 to 0.3% rare earths and impurities of Fe, Cu, Si, Ni, and Al in quantities of 0.01 to 0.03% each, have a low resistance to the formation of hot cracks (the critical rate of deformation is 0.5 to 0.75 mm/min) which significantly limits their possible use in welded constructions of complex form. The use of Zn concentrations in the base metal from 1.0 to 1.6% and the introduction of Mn does not significantly affect the critical deformation rate during welding. A reduction of the concentration of Ce by 2 to 3 times and the impurities (Fe, Cu, Si, and Al) by 2 to 4 times leads to a substantial improvement of the resistance of the alloy to the formation of hot cracks. The critical deformation rate then increases 2.5 to 3.5 times and reaches 1.8 to 1.9 mm/min. (tr-auth)

19382 HOT EMBRITTLEMENT OF AN AUSTENITIC-FERRITIC METAL CONTAINING 19% Cr, 12% Ni, AND 2% Mo, IN THE FORM OF A COATED ELECTRODE. Valibus, L.; Zacharie, G. (Electricite de France, Ecuelles). Mem. Sci. Rev. Met.; 71: No. 3, 195-203(Mar 1974). (In French).

From autumn meeting on metallurgy; Chatenay-Malabry, France (2 Oct 1974).

The embrittlement tests carried out on 4 batches of electrodes in stainless steel containing 19% Cr, 12% Ni, and 2% Mo are described: toughness tests at room temperature after holding at temperature between 400 and 850°C for times between 10 and 10000 hours; metallographic examination. An extrapolation of the results for a time of 100000 hours is proposed. (FR)

19383 HEAT EXPANSION IN THE COPPER-MOLYBDENUM SYSTEM. Ozhigov, L. S.; Khripkov, Yu. F. (Kharkov State Univ.). Fiz. Khim. Obrab. Mater.; No. 2, 151-153(1974). (In Russian).

The heat expansion of systems consisting of a Cu core and Mo windings and having a stable cohesion at the devision line was studied. The experimentally obtained values of the effective thermal expansion coefficient and of the temperature interval of the elastically stressed state for samples with different volume contents of the components agree with the calculated values. (tr-auth)

19384 OPTICAL PROPERTIES AND ELECTRONIC CHARACTERISTICS OF Nb AND Nb-Ti ALLOYS. Leksina, I. E. Tr. Fiz. Inst., Akad. Nauk SSSR; 72: 150-207(1974). (In Russian).

The optical constants of electrolytically polished niobium were measured in the spectral region of 0.4 to 10 μm at temperatures of 4.2, 78, and 293°K. The optical constants of electropolished cubic Nb-Ti alloys were measured at five alloy compositions of 25, 40, 52, 70, and 85 at % Nb in the infrared region of 1 to 10 μm at T = 293°K. For three of the alloys (25, 52, and 85 at % Nb) the region of study was expanded to the side of shorter wavelengths down to 0.4 μm. The sample surfaces were subjected to special experimental studies. It was found that the thickness of the cold-worked surface layer had an effect on the optical properties of electropolished metals. The optical properties of niobium and its titanium alloys are determined mainly by conduction electrons. (SJR)

19385 INFLUENCE OF A THERMAL CYCLE OF ELECTRON-BEAM WELDING ON WELD FORMATION AND PROPERTIES OF WELDED JOINTS BETWEEN NIOBIUM (VN-2AE) AND STEEL (Kh18N10T). Sivov, E. N.; D'yachenko, V. V. Svar. Proizv.; No. 4, 11-13(Apr 1973). (In Russian).

Electron-beam welding of Nb (VN-2AE) with steel (Kh18N10T) was studied with the aim of determining the influence of the thermal cycle of the welding on the weld formation and the strength of the welded joints. Heating Nb of 0.3 to 0.5 mm thickness to 1600°C, and 0.5 to 1.0 mm thickness to 1500°C, did not cause the formation of an intermetallic interlayer. The intermetallic interlayer was observed only when these temperatures were exceeded. A satisfactory strength of the joints was obtained when either no intermetallic interlayer was formed or when its mean thickness was $<2 \times 10^{-3}$ mm. (Metals Abstr.)

19386 IMPREGNATION OF THE MODEL OF A GRAPHITE BODY WITH LIQUID ZIRCONIUM. Kostikov, V. P.; Dergunova, V. S.; Shurshakov, A. N.; Posos'eva, G. D.; Lyukshin, E. N. Inorg. Mater. (USSR) (Engl. Transl.); 9: No. 11, 1699-1701(Nov 1973).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 9: No. 11, 1912-1915(Nov 1973).

The kinetic laws of the rise of liquid zirconium was investigated in a model of a porous body, consisting of a number of cylindrical channels of pyrographite not in mutual contact. The rates and energy characteristics of a number of elementary processes constituting impregnation were determined. The interphase energy at the liquid zirconium/pyrocarbon interface was calculated. (auth)

19387 CONCENTRATION DEPENDENCE OF THE PROCESS OF FORMATION OF A SOLID SOLUTION DURING SINTERING POWDER COMPRESSION OF TUNGSTEN-MOLYBDENUM. Veselkov, B. M.; Kulmanen, E. V.; Rykova, L. L.; Mokrov, A. P.; Shivrin, O. N. Fiz. Khim. Obrab. Mater.; No. 2, 132-136(1974). (In Russian).

The concentration dependence of the transfer of Mo into the solid solution was studied. A specific relation was established between the process of Mo introduction into the solid solution and the formation of concentrated inhomogeneities. (tr-auth)

19388 EFFECT OF ALLOYING ADDITIONS ON THE STRUCTURE OF THE CONTACT ZONE NICHROME-MOLYBDENUM COMPOSITION MATERIAL. Savchuk, A. N.; Ol'shanetskii, V. E.; Natapov, E. B. Fiz. Khim. Obrab. Mater.; No. 2, 127-131(1974). (In Russian).

The possibility of microalloying the Mo-matrix boundary with powders introduced in the composition material between the laminated matrix and the filler was studied. Alloys were added which promote the suppression of active and primary and collective recrystallization in the surface zone of the Mo wire. The possibility of controlling the structure of the contact zone between matrix and filler by supplementary microalloying of the matrix leading to optimum stability properties was shown. (tr-auth)

19389 ABSORPTION OF LOW ENERGY He^+ IONS BY LOW-ALLOY STEEL. Pokhodnya, I. K.; Shvachko, V. I.; Ustinov, V. G. Fiz. Khim. Obrab. Mater.; No. 2, 56-60(1974). (In Russian).

The efficiency of the absorption of He^+ ions was studied as a function of their energy by mass spectrometric methods. It was established that in the 1000 to 2000 eV range the efficiency of absorption does not depend on the energy and is $\sigma = 0.65$. A decrease of the energy below 1000 eV leads to a decrease of the absorption efficiency and at 10 eV the value of σ is 5.8×10^{-4}. (tr-auth)

Radiation Effects

Refer also to abstract 20168.

19390 (CONF-740651-3) EFFECTS OF NEUTRON RADIATION ON THE FATIGUE AND CREEP/FATIGUE BEHAVIOR OF TYPE 308 STAINLESS STEEL WELD METAL AT ELEVATED TEMPERATURES. Korth, G. E.; Harper, M. D. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). 1974. Contract AT(10-1)-1375. 16p. Dep. NTIS $4.00.

From symposium on the effects of radiation on structural materials; Gatlinburg, Tennessee, USA (11 Jun 1974).

Results from elevated-temperature, strain-controlled fatigue tests with and without hold periods at peak strain on specimens cut from Type 304 stainless steel plates welded using Type 308 stainless weld wire with controlled residual elements (CRE) are reported. Specimens were irradiated to fluences of 0.1 to 1.1×10^{22} n/cm^2 (E > 0.1 MeV) at 450 and 600°C, while the post-irradiation test temperature was 482 and 593°C. Irradiation reduced the fatigue life of the weld metal at 593°C by about one-half in the low cycle region (<5000 cycles to fail), but cyclic life was equivalent or slightly superior to the unirradiated material in the higher cycle region (>10,000 cycles to fail). At 482°C and at the lower fluence, the fatigue behavior of the irradiated specimens was about equivalent in the low-cycle region and superior in the high-cycle region. Introducing tensile hold periods at the peak strain of each fatigue cycle of the 593°C tests resulted in reductions in the fatigue life but at a much lesser rate than the base (parent) metal. Irradiation further reduced the life of the hold time tests. Hold periods had no significant effect at 482°C. Orientation effects were seen in all weld metal tests with the parallel orientation (specimen axis parallel to the weld seam) showing a superiority in cyclic life over those taken transverse to the welding direction. (auth)

19391 YIELD STRESS OF Zn, Pb, AND Sn CRYSTALS ELECTRON-IRRADIATED AT 80°K. Troitskii, O. A. (Inst. of Physical Chemistry, Moscow). Fiz.-Khim. Mekh. Mater.; 10: No. 2, 57-61 (1974). (In Russian).

Injection of electrons into the subject metal crystals under tension at low temperatures decreased the yield stress of the samples, competing with the radiation strengthening process. The limiting plasticity and strength increase, eliminating the process of brittle destruction of the metal at a later stage of deformation. (tr-auth)

19392 EFFECT OF ELECTRON IRRADIATION ON THE PRECIPITATION PHENOMENON OF Fe-C ALLOY. Takeyama, T.; Takahashi, H. (Hokkaido Univ., Sapporo). J. Jap. Inst. Metals; 38: No. 2, 138-143(Feb 1974). (In Japanese).

Vacancies and interstitials were produced in a solution-quenched Fe-0.025 wt% C alloy by using electrons ejected from a high-voltage electron microscope, and the effect of excess point defects on the aging behavior was studied. The specimens were irradiated for 20 min at room temperature by 650-kV electrons and heat treated and then examined with the electron microscope operated at 350 kV which did not exceed the threshold value of iron. The specimens aged below 240°C showed no visible precipitates in the irradiated area, but many small ϵ-carbide or cementite particles were observed in the nonirradiated area. As a large number of vacancies must remain in the irradiated area, it appears that supersaturated carbon atoms migrate to individual vacancies and are trapped by them to form C-V pairs (V : vacancy), resulting in the suppression of the carbide precipitation. The dissociation of the C-V pair and the precipitation of the cementites in the irradiated area were observed at temperatures

above 240°C. The C–V pair is highly stable even at the precipitation temperature of the cementite because of the high binding energy between carbon atoms and vacancies. An unusual growth of cementite particles was observed in the irradiated area after aging above 250°C. In this case, carbon atoms leaving from the traps may contribute to the nucleation and/or the growth of the cementite. Furthermore, the vacancies may be absorbed to the cementite/matrix interface in order to release the coherency strain developed during the growth of precipitate, thus accelerating the growth of the cementite. (auth)

19393 RECOVERY OF IRRADIATED Fe–Al–N ALLOYS. Yamane, T.; Takahashi, J.; Mima, G. (Osaka Univ., Suita, Japan). J. Nucl. Sci. Technol. (Tokyo); 11: No. 3, 99-103(Mar 1974).

Two kinds of Fe–Al–N alloy were irradiated in the JRR-2 reactor with neutron doses of 1 to 2×10^{19} n/cm^2 at about 60°C. Using internal friction and torsion test techniques, the atomistic behavior of the structure was studied through observation of the changes brought to the mechanical properties by neutron irradiation and subsequent annealing. The internal friction measurements revealed that irradiation brought about release of nitrogen from Fe_4N and AlN. Moreover, the damping curves indicated, upon analysis, the existence of two new peaks, at ~120 and ~145°C. With annealing, recovery of radiation hardening started from a temperature between 150 and 200°C, and terminated by ~350°C. (auth)

19394 BUILDUP OF POINT-DEFECT DIFFUSION PROFILES IN A FOIL DURING IRRADIATION. Rothman, S. J.; Lam, N. Q.; Sizmann, R. (Argonne National Lab., IL). Radiat. Eff.; 20: No. 4, 223-227(1973).

The distribution of interstitials and vacancies in a foil under irradiation was calculated as a function of both distance from the surface and irradiation time by solving the diffusion equation numerically on a computer. The defects were considered to annihilate at randomly distributed sinks, by mutual recombination, and by diffusion to the surface. Defect jump frequencies appropriate to silver at 125°C and foil thicknesses of 1 μm and 300 Å were used. Large "humps" in the plot of vacancy concentration versus distance were found near the surface of the 1 μm foil at short irradiation times, unless the internal sink concentration was high. These humps may be responsible for some unusual void distributions observed near grain boundaries. (auth)

19395 THEORY OF VOID AND INTERSTITIAL DISLOCATION LOOP GROWTH IN IRRADIATED METALS. Konobeev, Y. V.; Subbotin, A. V.; Golubov, S. I. (Inst. of Physics and Power Engineering, Obninsk, USSR). Radiat. Eff.; 20: No. 4, 265-271(1973).

The nucleation and growth kinetics of voids and interstitial dislocation loops in irradiated metals is theoretically considered. Taking into account a slight dependence of void swelling on the void concentration the void and dislocation loop nucleation rates are approximated by expressions allowing an analytical treatment of the problem. It is shown that at sufficiently high doses, the maximum void swelling depends on the number of displacements produced by bombarding particles only. The equations for dependence of void and dislocation loop concentration and void swelling on dose are derived. The mechanism of void swelling saturation due to ceasing of loop growth at large doses is discussed. (auth)

19396 STEADY-STATE IRRADIATION CREEP. Heald, P. T.; Speight, M. V. (Berkeley Nuclear Labs., Eng.). Phil. Mag.; 29: No. 5, 1075-1080(May 1974).

A dislocation climb model of the low-temperature, steady-state, irradiation creep of nonfissile materials is presented. The predicted creep rate is a linear function of the applied stress and the irradiating flux and is independent of temperature. (auth)

19397 EFFECTS OF NEUTRON IRRADIATION DAMAGE ON THE SUPERCONDUCTING PROPERTIES OF Nb_3Sn. Bett, R. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Cryogenics; 14: No. 7, 361-366(Jul 1974).

Specimens of Nb_3Sn were irradiated by fast neutrons at 70°C to doses in the range 3×10^{21} to 9×10^{23} neutrons m^{-2}. Their critical temperatures were depressed linearly with dose, to less than 4.2°K after about 3×10^{23} neutrons m^{-2}. The critical temperature recovered to their initial values in anneals of 2 hours at 900°C, and in 64 hours at 750°C. The critical current can be enhanced by low neutron doses, particularly at high fields, but is always depressed by higher doses. The observations are shown to be consistent with a qualitative model, and in the light of this the likely consequences of irradiation at operating temperature are considered. (auth)

19398 EFFECT OF TANTALUM AND YTTRIUM ADDITIONS ON THE RECRYSTALLIZATION OF TITANIUM. Teremetskii, V. A.; Kashchuk, V. A. Sb. Nauch. Tr., Tomsk. Inzh.-Stroit. Inst.; 21: 117-119(1973). (In Russian).

Specimens of 0.1 mm thickness cut from 60% deformed cold-rolled sheet were used to study the recrystallization kinetics of the single phase α-alloys: Ti–0.41% Ta and Ti–0.35% Y after annealing for 10 to 10^4 s at 470, 530, and 575°C. Such small additions of Ta raise the activation energy, E, and the onset temperature, T, of Ti recrystallization, whereas Y has almost no effect on E but significantly lowers T. (Ref. Zh.)

19399 ELECTRON DOSE DEPENDENCES OF IRRADIATION HARDENING AND ACTIVATION VOLUME IN COPPER SINGLE CRYSTALS. Yoshizawa, I.; Naramoto, H.; Kamada, K. (Japan Atomic Energy Research Inst., Tokai). J. Phys. Soc. Jap.; 36: No. 1, 202-206(Jan 1974).

The irradiation induced hardening and change in thermal activation volume of plastic deformation in Cu single crystals were measured after electron irradiation in the dose range of $1 \times 10^{16} \sim 8 \times 10^{17}$ electrons/cm^2 at 1.8 MeV. Different dependences on the electron dose were found in the lower and the higher dose ranges with boundary of about 1×10^{17} electrons/cm^2 between them in both hardening and activation volume. Thermodynamic analysis of the result showed that intrinsic interaction energy between dislocation and obstacle, which is expected to be independent of the length of dislocation segment, decreases sharply from about 3 eV as the dose increases in the lower dose range, and tends to saturate to the value less than 0.3 eV in the higher dose range. (auth)

19400 INFLUENCE OF MAGNESIUM IMPURITY ATOMS ON THE ANNEALING KINETICS OF LOW-TEMPERATURE NEUTRON-IRRADIATED ALUMINIUM. Kontoleon, N.; Papathanassopoulos, K.; Chountas, K. (Democritus Nuclear Research Center, Athens). Radiat. Eff.; 20: No. 4, 273-282(1973).

The influence of Mg atoms in stages II and III of Al are investigated from the recovery of the residual electrical resistivity of Al and a series of Al–Mg alloys (nominally 0.02 to 0.7 at. %) at a total neutron dose of 9×10^{16} n/cm^2 at liquid nitrogen temperature. Isochronal annealing studies were performed for a temperature range 78 to 350°K with different heating rates (0.5 deg/min for 78 to 235°K and 1 deg/min for 245 to 345°K). Isothermal annealing for 215°K was carried out for a total period of 136 min. Annealing of stage III occurs by a second-order process with an activation energy 0.602 ± 0.03 ev for pure Al and its alloys. The activation energy is consistent with that from quenching experiments, thus favoring the vacancy motion model. Substages in both stage II (127 and 145°K) and stage III (190 and and 245°K) are apparent. Substages of stage II are interpreted as being due to the breakup of interstitials from impurity atoms. An interesting feature is the substage at the limits of stages III and IV, which appears in the alloys and increases with Mg content. Trapping of vacancy-type defects during their migration in stage III can explain the results. A reverse electrical resistivity recovery was observed at the high temperature limits of stage III and was attributed to the formation of Guinier–Preston zones. (auth)

19401 CURRENT METALLURGICAL PROBLEMS IN THE ELECTRONUCLEAR INDUSTRY. Grison, E.; Weisz, M. (CEN de Saclay, Gif-sur-Yvette, France). Mem. Sci. Rev. Met.; 70: No. 9, 615-624(Sep 1973). (In French).

From autumn meeting on metallurgy; Chatenay-Malabry, France (2 Oct 1972).

Specific problems associated with the use of metals in reactor construction are presented: burst slugs; radiation embrittlement of Zircaloy claddings at about 300°C; radiation embrittlement of austenitic steels at 600°C; radiation-induced creep; and radiation-induced swelling. (FR)

19402 LOW TEMPERATURE DECHANNELING BY RADIATION DEFECTS IN IRON. Jousset, J. C.; Lorenzelli, N. (CEN, Fontenay-aux-Roses, France). J. Phys. (Paris), Colloq.; No. 5, 105-109(1973). (In French).

From centenary congress of the French Physical Society; Vittel, France (28 May 1973).

Dechanneling effects produced by defects created in iron by ^{235}U fission products were studied: an iron sample is sandwiched between two sources consisting of 4 deposits of enriched ^{235}U having unequal thicknesses. Low-temperature annealings were carried out after having irradiated the samples at 20°K with neutrons. In the case of the channeling patterns obtained, the contrast existing between the irradiated and the nonirradiated zones of the sample disappeared progressively during annealing. There was no visible contrast differences in the channeling patterns obtained after an annealing at a maximum temperature (485°K). The curve representing the variation in dechanneling as a function of the fluence of the fission fragments exhibits a damage saturation effect. The dechanneling effects disappear during annealing in three stages (110°K, 130-220°K, 280-400°K). The

self-interstitials undergo the most significant dechanneling when in cluster form. Carbon interstitials have dechanneling cross sections similar to that of hydrogen in palladium. (FR)

19403 EFFECT OF NEUTRON IRRADIATION ON THE MICROSTRUCTURE AND PROPERTIES OF WELDED JOINTS OF HIGH CONCENTRATION CHROMIUM FERRITE STEELS. Karasev, V. S.; Kazenov, Yu. I.; Votinov, S. N.; Slavuta, V. I.; Bobylev, A. P.; Krylov, E. A.; Shinakov, A. A.; Reviznikov, L. I.; Sychev, A. S.; Khramtsov, V. F. Avtomat. Svarka; No. 5, 6-9(May 1973). (In Russian).

High-temperature neutron irradiation was shown to increase the rate of diffusion processes in welded joints of the Cr steels Kh13M2BFR and OKh14N5M2. (tr-auth)

19404 POSSIBILITY OF DI-VACANCY MIGRATION AT 0°C IN IRRADIATED GERMANIUM. Hirata, M.; Fukumoto, M. (Osaka Univ., Toyonaka, Japan). Jap. J. Appl. Phys.; 13: No. 1, 8-16(Jan 1974).

An investigation was made on the electron bombardment-induced defects and their annealing stage at around room temperature. The nature of the recovery stage known as III_B^A can be interpreted as due to the migration of divacancies with the migration energy of 0.75 eV. In order to understand the experimental fact that the concentration of III_B^A defects is approximately proportional to the square of the total electron flux, the formation process of di-vacancies is discussed by using rate equations. The role of group V impurity atoms in this stage is also examined. (auth)

19405 POINT DEFECT CLUSTERS IN ELECTRON-IRRADIATED GOLD. Yoshida, N.; Kiritani, M. (Osaka Univ., Toyonaka, Japan). J. Phys. Soc. Jap.; 35: No. 5, 1418-1429(Nov 1973).

Defect formation in gold by the irradiation of 2.0 ~ 2.5 MeV electrons was studied using a high voltage electron microscope. The formation of dislocation loops by the aggregation of interstitials generally precedes the formation of the defects by vacancies. Permanent sinks, such as specimen surfaces and dislocations, prevent the formation of interstitial type of defects and enhance the formation of vacancy clustered defects. A rapid formation of the vacancy type defects and the simultaneous shrinkage of interstitial type loops after the cessation of the irradiation are observed. Kinetics analysis of the point defect behavior, standing on the random migration of interstitials and vacancies, explains all the observed various phenomena as the competition processes between two kinds of point defects under various circumstances. The irradiation intensity dependence of the density of interstitial type defects shows that the di-interstitials are their stable nucleus. (auth)

19406 REMEDYING PUNCTIFORM DEFECTS CREATED BY IRRADIATION AT 20K IN AN ALLOY Fe–Al 40 AT. %. Riviere, J. P.; Zonon, H.; Grilhe, J. (CNRS, Poitiers, France). Acta Met.; 22: No. 8, 929-936(Aug 1974). (In French).

Some test bars made of an Fe–Al 40 at. % alloy, either annealed or hardened in oil at 900 and 1000°C, were irradiated by neutrons at 20°K with a dosage of about 7.3×10^{17} neutrons/cm^2 (E > 1 MeV and then tempered. The isochrone restoration in situ of the electric resistivity after irradiation revealed three main stages on the annealed bars and five on the hardened ones. The excess of resistivity introduced by the irradiation was completely restored in the first three stages. The two remaining stages observed on the hardened bars were due to the migration and elimination of lacunae. The third stage, in which the greater part of the resistivity excess caused by the irradiation was restored, was attributable to the migration of the interstitials. The activation energy for this stage was 1.35 eV. The order of the reaction was close to second order. (10 figures) (auth)

19407 KINETICS OF THE ACCUMULATION OF RADIATION DEFECTS IN SILVER–ZINC ALLOY AT THE TEMPERATURE OF THE SECOND STAGE OF RECOVERY. Sadykhov, S. I. O.; Platov, Yu. M. Fiz. Khim. Obrab. Mater.; No. 2, 98-100(1974). (In Russian).

The kinetics of the accumulation of radiation defects in Ag–13.6% Zn during electron irradiation at an intensity of 3×10^{12} cm^{-2} sec^{-1} were studied by measurement of the electrical resistance in the temperature interval from 100 to 170°K. The electron energy was 2.3 MeV. The rate of introduction of radiation defects in the alloy does not depend on the irradiation temperature. An increase in the electrical resistance at the temperature of the II stage in the irradiated alloy was absent. The results are discussed. (tr-auth)

19408 HELIUM INTERACTION WITH VACANCY CLUSTERS IN TUNGSTEN. Caspers, L. M.; van Dam, H.; van Veen, A. (Delft Univ. of Tech., Netherlands). Delft Progr. Rep., Ser. A; 1: No. 2, 39-44(Feb 1974).

Activation energies for the interaction of helium with vacancies and vacancy clusters in tungsten have been calculated. The results are compared with experimental data obtained by Kornelsen [Radiat. Eff. 13: 227-236(1972)]. An alternative model for the formation of larger clusters during desorption is suggested, based on the mobility of divacancies and trivacancies containing less than three helium atoms. (auth)

Other Materials

Refer also to abstracts 18579, 19236, 19386, 19504, and 20367.

19409 ABOUT THE DISPLACEMENT OF THE LITHIUM ION IN LITHIUM FLUORIDE BY ACCELERATED ELECTRONS. Herrmann, F.; Pinard, P.; Farge, Y. (Institut National des Sciences Appliquees, Villeurbanne, France). J. Phys., C (London); 7: No. 11, L199-L201(7 Jun 1974).

LiF crystals were irradiated at low temperature with electrons of energies less than 10 keV to detect the displacement threshold of the lithium ion by measuring the optical absorption in the I band. It has been found that the threshold energy is equal to or smaller than 1.64 eV if there is one at all. (auth)

19410 EXPERIMENTAL AND PREDICTED STABILITY OF GASEOUS DITRANSITION METAL DICARBIDES. Gingerich, K. A. (Texas A and M Univ., College Station). J. Chem. Phys.; 60: No. 9, 3703-3704(1 May 1974).

Experimental information about the stability and molecular structure of $RhCeC_2$, $PtCeC_2$, $PtThC_2$, and $IrThC_2$ is reported. (LK)

19411 THERMAL DIFFUSIVITY OF UP AND US FROM 100 TO 1,000K. Kamimoto, M.; Takahashi, Y.; Mukaibo, T. (Tokyo Univ). J. Nucl. Sci. Technol. (Tokyo); 11: No. 4, 158-159(Apr 1974).

The thermal diffusivity of very pure UP and US (0.05 wt% total impurities) was measured at 77 to 1,000°K by the laser flash method. Results show a sharp minimum at the magnetic transition of UP at 121°K and of US at 180°K. Above the transition temperature, the thermal diffusivity has almost the same temperature dependence as that of UN. The gentle hump in the curve for UP, with its max at about 600°K, is peculiar. (DLC)

19412 EFFECT OF UNIAXIAL STRESS ON THE GR1 DOUBLET IN DIAMOND. Davies, G.; Penchina, C. M. (King's Coll., London). Proc. Roy. Soc. (London), Ser. A; 338: No. 1614, 359-374(28 Jun 1974).

In 1973, Clark & Walker (Proc. R. Soc. Lond.; A 234: 241-257 (1973)) showed that the GR1 doublet splits, under uniaxial stresses, in a way closely characteristic of transitions between E and A ground states and a T excited state. To clear up certain anomalies in their results, and to extend the analysis, independent experimental results are described in this paper. It is shown that the stress dependence of the energies of the GR1 lines may be understood by diagonalizing the Hamiltonian of the perturbed GR1 centre, with good agreement between theory and experiment. Under stress, the E and A ground states are strongly coupled. The new eigenstates are calculated and shown to account for the stress dependence of the intensities of the A to T transition. (auth)

19413 ANELASTIC RELAXATION PEAKS IN GRAPHITES AFTER NEUTRON IRRADIATION AT LOW TEMPERATURE. Rouby, D. (Institut National des Sciences Appliquees, Villeurbanne, France); Gobin, P. F.; Bonjour, E. Phil. Mag.; 29: No. 5, 983-999(May 1974).

Internal friction experiments (torsion at 1 Hz and flexion at 300 Hz) were performed on pyrolytic and nuclear graphite after neutron irradiation at liquid nitrogen temperature. In the data at 1 Hz, two small peaks are observed at 112°K(P_1'; 0.24 eV) and at 135°K(P_1''; 0.28 eV), and a further sharp peak appears at 375°K (P_3; 0.8 eV). The frequency factors are close to 10^{11} Hz. These peaks are described in terms of relaxation by point defects. Analysis of the effect of varying the neutron dose and of annealing on the P_1' and P_3 peaks shows that both peaks are due to the same defect species. At low temperature these defects have triclinic symmetry and give rise to P_1' peak, but at higher temperatures their symmetry becomes monoclinic, as a result of thermal activation, and they then give rise to the P_3 peak. Various types of defect structures are discussed in relation to the effects of annealing on a number of physical properties. (auth)

19414 APPLICATION OF FRACTURE MECHANICS TO GRAPHITE UNDER COMPLEX STRESS CONDITIONS. Yahr, G. T.; Valachovic, R. S. (Oak Ridge National Lab., TN). pp 863-873 of Fracture Mechanics of Ceramics. Vol. 2. Bradt, R. C. (ed.). New York; Plenum Publishing Corp. ([nd]).

The applicability of linear-elastic fracture mechanics to

graphite under multiaxial stress conditions was examined. The specimens were thick-walled graphite cylinders with flat heads which were internally pressurized. Two series of specimens were used. The first series had complete circumferential notches machined diagonally into the head-cylinder juncture region, while the second series was unnotched. The methods of linear-elastic fracture mechanics and a finite-element analysis were used to predict pressures to cause fracture for both notched and unnotched specimens. In the latter case, it was necessary to postulate a "size" for a naturally occurring flaw. These predicted pressures were in good agreement with measured results for the vessels with machined notches. The unnotched vessels, however, withstood a greater pressure than was predicted, but the agreement is considered good because the flaw sizes used were inferred from tests on other specimens and hence were very approximate. Results indicate that fracture mechanics can be a valuable technique for predicting fracture of graphite under complex stress states, with the method being especially useful where regions of high stress concentration exist. (5 tables) (auth)

19415 STRENGTH OF PYROGRAPHITE IN CONTACT WITH LIQUID ALKALI METALS. Kostikov, V. I.; Kosbelev, Yu. I. (Moscow Inst. of Steel and Alloys). Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 7, 18-20(1973). (In Russian).

Equipment is shown for determining the strength of pyrographite perpendicular to the basal plane in contact with liquid metals. Strength determinations were made at precipitation temperatures of 1950 and 2100°C in air and in contact with liquid sodium. The strength of pyrographite in contact with liquid sodium decreased with increase in temperature. In liquid potassium at the melting point, samples disintegrated into thin plates, which is related to formation of inter-layer graphite compounds. The results obtained may be used in selecting regimes for work with graphite in contact with alkali metals. (tr-auth)

19416 ESTIMATION OF STORED CHARGE BY ELECTRON BEAM IRRADIATION. Kobayashi, M. (Musashino Electrical Communication Lab., Tokyo). Denki Tsushin Kenkyusho Kenkyu Jitsuyoka Hokoku; 22: No. 9, 2359-2370(Sep 1973). (In Japanese).

The method of estimation of injected carrier density by capturing the secondary electrons produced by the irradiation of electron beam on semiconductors, and the comparison of the results of estimation with theoretical calculation are described. The purposes of experiment were the confirmation of the variation of trapping rate of secondary electrons by the carrier stored in semiconductor crystals, and the determination of relation between the carrier concentration stored in semiconductors and the trapping rate of secondary electrons. The experiment was carried out on samples in which carrier injection was made by the normal direction current of p-n junction and by avalanche injection. The calculation was made by the program based on Gummel method for the increase of the carrier density of semiconductors, and the relation between the concentration of impurity on injection side and required injected current density was obtained. It was found that the estimation of stored charge is possible with characteristic curve, when the experiment is carried out in the range of the injected current density of 10^2 to 10^4 A/cm^2 in case the concentration of impurity on injection side is 10^{21} cm^{-3}, and in the range of 10^2 to 10^3 A/cm^2 in case of about 10^{17} cm^{-3} of the concentration of impurity, as the experimental value was in agreement with the calculated value. (JA)

19417 FUSIBILITY DIAGRAM OF THE SYSTEM NaCl–KCl–UCl_3. Desyatnik, V. N.; Dubinin, B. V.; Raspopin, S. P. (Ural Polytechnic Inst., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 1, 61-62(1974). (In Russian).

The fusibility of the ternary system NaCl–KCl–UCl_3 was studied. Mixtures with compositions close to the ternary eutectic melted at relatively low (up to 500°C) temperatures. The melts could be used for electrolytic recovery of uranium. (tr-auth)

19418 OPTICAL STUDY OF U^{5+} IN ZIRCON. Vance, E. R.; Mackey, D. J. (Australian National Univ., Canberra). J. Phys., C (London); 7: No. 10, 1898-1908(21 May 1974).

Polarized absorption spectra of nine natural zircons from various sources have been obtained at low temperatures over the 350 to 2500 nm range. In addition to absorption peaks due to U^{4+}, a set of peaks was observed in the infrared, in the 1000 to 1500 nm range. In some samples, this spectrum dominated the U^{4+} spectrum. High-temperature annealing was necessary in most samples to distinguish the U^{4+} and extra spectra. From measurements of the intensity of the U^{4+} spectrum as a function of total uranium content, it was concluded that U^{5+} was the source of the extra absorption peaks. Synthetic samples, doped with both yttrium and uranium, displayed only the extra spectrum, showing that trivalent impurities can stabilize U^{5+}. The two strongest lines of the extra spectrum displayed Zeeman effects with the magnetic field applied both parallel and perpendicular to the c axis, and the results suggest a possible reason for the non-observation of U^{5+} in previous electron-spin resonance studies of zircon. The spectrum expected from U^{5+} in zircon is discussed briefly and pairing of U^{5+} ions in the samples was indicated. (auth)

19419 EFFECT OF NEUTRON RADIATION ON CHARACTERISTICS OF CdS–CrS, CdS–BiS, CdS–Cu_{2-x}Te AND CdS–Cu_{2-x}S PHOTOELEMENTS. Konstantinova, E. M.; Kanev, S. K.; Ribarov, S. R. (Inst. of Solid State Physics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 27: No. 4, 457-460(1974).

Effects of neutron irradiation on the spectral and current characteristics of photoelectric converters were investigated. The spectral peak of electron transitions in pure CdS disappears, and a new peak appears at 605 nm. The characteristics of CdS–CrS are improved after irradiation, and this photoelement is more radiation-resistant than the others. (DLC)

19420 THERMOLUMINESCENCE OF ALKALI HALIDES IRRADIATED AT 80K. Marti, Y. V. G. S.; Murthy, K. R. N. (Indian Inst. of Tech., Madras). J. Phys., C (London); 7: No. 10, 1918-1928(21 May 1974).

Thermoluminescence and optical absorption studies are made on NaCl, NaCl : Cu, KCl, KCl : Cu, KBr and KBr : Cu crystals irradiated by x-rays at 80°K. Treated NaCl crystals exhibit a strong first-order glow peak located at 194°K with a trap depth of 0.52 eV. Based on F light stimulation experiments and by comparison with the known thermal activation energy of F′ centers, the filled trap is attributed to the F′ center. Copper doping suppresses the 194°K peak and gives rise to two glow peaks centered at 225 and 280°K. Measurements of changes in the Cu^0 absorption band and experiments with different concentrations of the impurity are used to identify the 225°K peak with the thermal decay of Cu^0 centers. First-order kinetics is applicable and a trap depth of 0.66 eV is deduced. A strong peak in KBr at 187°K with a trap depth of 0.32 eV and a prominent peak in KCl at 219°K with a trap depth of 0.40 eV are attributed to the decay of F′ centers. Two main glow peaks of first-order kinetics are observed in KCl : Cu crystals at 207 and 243°K with trap depths of 0.28 eV and 0.53 eV respectively. Comparison with changes in optical absorption spectra suggests correlation of the 207°K peak with V_K centers and the 243°K peak with Cu^0 centers. (auth)

19421 IMPROVED MECHANICAL PROPERTIES OF COMPOSITES REINFORCED WITH NEUTRON-IRRADIATED CARBON FIBERS. McKague, E. L. Jr.; Bullock, R E.; Head, J. W. J. Compos. Mater.; 7: No. 3, 288-296(Jul 1973).

Mechanical property improvements of neutron-irradiated carbon fibers are reviewed, and an experiment is described which verifies that mechanical properties of carbon-epoxy laminates are improved when reinforced with such fibers. Increased flexural and shear strengths of composites are confirmed to result from the use of irradiated fibers. The future potential of radiation treatment of carbon fibers to improve mechanical properties of composites is discussed; it is concluded that the process offers commercial promise. (auth)

19422 FABRICATION OF ELECTRICALLY INSULATING REGIONS IN OPTICAL DEVICES BY PROTON BOMBARDMENT. D'Asaro, L. A.; Dyment, J. C.; Kuhn, M.; Spitzer, S. M. (to Bell Telephone Labs.). US Patent 3,824,133. 16 Jul 1974. Filed date 2 Dec 1971. 12p.

A method of fabricating electrically insulating regions of low optical absorption in optical devices, such as junction lasers and incoherent light emitting diodes, is described. The technique includes the steps of (1) irradiating the desired regions with high-energy protons which advantageously produce high resistivity but disadvantageously also produce high optical absorption and (2) subsequently annealing these regions for a time and at a temperature effective to reduce substantially the proton-induced optical absorption while retaining the proton-induced resistivity at a level sufficient for electrical insulation. Detailed parameters for irradiating and annealing are given for GaAs and GaP. Specifically described are applications of this technique in the passivation of p–n junctions and in the fabrication of stripe geometry junction lasers. (Official Gazette)

19423 NUMERICAL CALCULATIONS OF IMPURITY PROFILES AND ENERGY TRANSFER DURING INTERMEDIATE ENERGY ION IMPLANTATION. Comparison with Experiment. Combasson, L. (CEN, Grenoble, France). J. Phys. (Paris), Colloq.; No. 5, 29-34(1973). (In French).

From centenary congress of the French Physical Society; Vittel, France (28 May 1973).

The paths of heavy ions slowing down in an amorphous material

were studied together with the spatial distribution of the damage caused by an incident ions and the associated collision cascade during an ion implanting process. The Winterbon model was adopted. Results are in good agreement with experimental values. (FR)

19424 HIGH TEMPERATURE THERMOLUMINESCENCE OF GAMMA-IRRADIATED CaF_2–Re (RARE EARTH) F_3 CRYSTALS. Kaipov, B.; Tavshunskii, G. A.; Kalekov, A. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk: No. 1, 68-69(1974). (In Russian).

The rare earth activator content was 0.1 to 1 wt %. The following model is proposed for the high-temperature thermoluminescence: Re^{2+} (rare earth) in cubic lattices is the most stable, and liberation of holes from various traps in the high-temperature region takes place in the form of internodal atoms of fluorine. In this case independent of the type of liberated hole trap, the electron and hole will recombine after deposition of the fluorine near the cubic Re^{2+} internode and the Re^{3+} will luminesce at a tetragonal node. It is assumed that this mechanism is determining for thermal light emission above 320°C for gamma-irradiated crystals of CaF_2–ReF_3 (Re is Pr, Nd, Sm, Eu, Tb, Dy, Ho, Er, or Tm). (SJR)

19425 EFFECT OF RADIATION ON THE FATIGUE STRENGTH OF POLYETHYLENE AND POLYCARBONATE. Agamalyan, S. G. Fiz.-Khim. Mekh. Mater.; 10: No. 3, 107-108(1974). (In Russian).

The γ irradiation of plastics at different doses affects the fatigue strength as a function of the form of fatigue breakdown. With increasing dose, the index α_k (relating to the thermal form) increase but α_p (characterizing the mechanical form of breakdown) decreases. (tr-auth)

19426 EFFECTIVE GAUNT FACTORS FOR ELECTRON IMPACT EXCITATION OF MULTIPLY-CHARGED NITROGEN AND OXYGEN IONS. Davis, J. (Naval Research Lab., Washington, DC). J. Quant. Spectrosc. Radiative Transfer; 14: No. 7, 549-554(Jul 1974).

Electron impact excitation Gaunt factors and thermally averaged Gaunt factors were obtained for the resonance and several nonresonance transitions for various ionization stages of nitrogen and oxygen. In those cases where comparisons could be made, the agreement was good. In addition, a simplified expression for the Gaunt factor was suggested by the data. (auth)

19427 ESR STUDY OF RADIATION DAMAGE CENTERS IN ADP:K_2SeO_4 MIXED CRYSTALS. Kawano, T.; Furukata, K. (Kagoshima Univ., Japan). J. Phys. Soc. Jap.; 35: No. 6, 1791 (Dec 1973).

19428 ESR STUDY OF NEUTRON-IRRADIATED LiF CRYSTALS. Kazumata, Y. (Japan Atomic Energy Research Inst., Tokai). J. Phys. Soc. Jap.; 35: No. 4, 1442-1449(Nov 1973).

The paramagnetic centers produced in LiF crystals by neutron-irradiation at different temperatures have been studied by ESR. The F-like centers, including F-centers, clustered F-centers, and electrons trapped in vacancy clusters, are observed in the crystal irradiated at about 0°C. By irradiation at 80°K, however, the concentration of F-like centers is small, and the molecular ion centers predominate. The two types of interstitial centers, stable even at room temperature, are also observed in this irradiation; models are proposed for the two types. Neutral hydrogen (H^0) and tritium (T^0) atoms are observed in the irradiations at both room temperature and 80°K. These atoms are trapped in vacancy clusters in the crystals. It is suggested from the results of irradiations between 0°C and 80°K that vacancies evaporated from the zone play an important role in formation of the F-centers. The effects of fast neutrons at liquid helium temperature are described. (auth)

19429 SPECIFIC HEATS OF ^{7}LiH AND ^{7}LiD AT LOW TEMPERATURES. Yates, B.; Wostenholm, G. H.; Bingham, J. L. (Univ. of Salford, Eng.). J. Phys., C (London); 7: No. 10, 1769-1778(21 May 1974).

Measurements of the specific heats of ^{7}LiH and ^{7}LiD between approximately 5 and 320°K are reported. These results are believed to be accurate within 2% down to 50°K, falling to approximately 10% at the lowest temperatures. It is suggested that peaks in the otherwise smooth variations of specific heat with temperature, which occur at 11.1 ± 0.2°K in the case of ^{7}LiH and 12.8 ± 0.2°K in the case of ^{7}LiD, may be associated with transformations to the cesium chloride structure. Using the present data in association with the limited ancillary data available from other sources, it is concluded that the Gruneisen parameters probably rise with falling temperature. Moments of the frequency distributions of the compounds have been calculated with the aid of the quasiharmonic approximation, some of which have been used to deduce properties of the vibrational frequency spectra which are consistent with infrared absorption and transmission characteristics. (auth)

19430 ACCELERATED DIFFUSION IN SILICON RESULTING FROM IRRADIATION. Study of the Kinetics and Distribution of Impurities. Baruch, P. (Ecole Normale Superieure, Paris); Bouvatier, M.; Picard, C.; Epelboin, Y.; Monnier, J.; Netange, B. J. Phys. (Paris), Colloq.; No. 5, 131-136(1973). (In French).

From centenary congress of the French Physical Society; Vittel, France (28 May 1973).

The existence of an accelerated diffusion of boron and phosphorus in silicon as a result of irradiation was established. The irradiations were effected with protons having 200 to 600 keV energies for temperatures lying between 700 and 900°C, and in the 5 to 30 keV range for temperatures lying between 600 and 700°C. Concentration profiles were studied using ion microanalysis techniques, and nuclear and electrical methods. The simple vacancy diffusion model is incapable of explaining all of the observed phenomena. The considerable variation in the diffusion lengths of vacancies in samples of the same origin leads to the seeking of a more elaborate model in which the various reciprocally interacting defects intervene. (FR)

19431 STUDY OF DEFECTS PRODUCED BY ION IMPLANTATION OF SILICON. III. Using Transmission Electron Microscopy. Truche, R.; Dupuy, M.; Lafeuille, D. (CEN, Grenoble, France). J. Phys. (Paris), Colloq.; No. 5, 93-98(1973). (In French).

From centenary congress of the French Physical Society; Vittel, France (28 May 1973).

Silicon samples were implanted with phosphorus (10^{16} atoms/cm^2 at 30 keV) and arsenic (10^{15} atoms/cm^2 at 50 to 140 keV). In the case of phosphorus, electron microscope observations revealed an amorphous layer epitaxially recrystallizing on the substrate at 650°C. The behavior of defects such as dislocation loops and dipoles were studied during annealing at higher temperatures. In the case of arsenic, the recrystallization of the amorphous layer was accompanied by microtwinning and the formation of various types of defect (100ps, linear defects etc.). (FR)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstract 18624.

19432 (INIS-mf-1178) ORGANIZATION OF THE INVENTORY OF FISSILE MATERIALS. Speeckaert, P.; de Backer, J. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 1973. 18p. (In French). INIS.

Rule No. 8 of the Euratom Treaty requires member states to report regularly their fissile material holdings, in particular the Belgian Nuclear Research Center. These monthly statements must be in such form that at any time it would be possible to show the amount of any material and where it is, in such a way that physical control of fissile material is possible. The monitoring groups also have the facilities for confirming weights and of sampling for chemical or isotopic analysis. The Nuclear Research Center meets these requirements with its accountability program. (tr-auth)

19433 (REG/G-5.24(6-74)) ANALYSIS AND USE OF PROCESS DATA FOR THE PROTECTION OF SPECIAL NUCLEAR MATERIAL. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jun 1974. 7p. DRS.

The guide describes and identifies characteristics of a facility information system acceptable to the Regulatory staff for analyzing and using process yield and other information from run sheets, operating logs, and job orders to enhance material control by early detection of special nuclear material thefts. (auth)

19434 (REG/G-5.25(6-74)) DESIGN CONSIDERATIONS FOR MINIMIZING RESIDUAL HOLDUP OF SPECIAL NUCLEAR MATERIAL IN EQUIPMENT FOR WET PROCESS OPERATIONS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jun 1974. 7p. DRS.

This regulatory guide describes design features and characteristics acceptable to the Regulatory staff for minimizing the residual holdup of SNM after draindown or cleanout of equipment used in wet process operations. These features and characteristics are expected to facilitate physical inventory measurements and ameliorate material balance uncertainties without interfering with process operations. In particular, this guide is addressed to operations including: liquid blending and gas-liquid contacting; liquid transfer and storage; precipitation; slurry transfer; and liquid-solid separations. (auth)

19435 (REG/G-5.27(6-74)) SPECIAL NUCLEAR MATERIAL DOORWAY MONITORS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jun 1974. 12p. DRS.

Special nuclear material doorway monitors provide an efficient, sensitive, and reasonably unobtrusive means of searching individuals exiting from a material access area for concealed SNM. With proper installation and operation, gram quantities or less of SNM can be detected with a high level of reliability while maintaining a low false alarm rate. This guide describes means acceptable to the Regulatory staff for employing SNM doorway monitors. (TFD)

19436 (REG/G-5.29(6-74)) NUCLEAR MATERIAL CONTROL SYSTEMS FOR NUCLEAR POWER PLANTS. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jun 1974. 1p. DRS.

This guide identifies elements acceptable to this Regulatory Staff for a nuclear material control system for nuclear power reactors. (TFD)

19437 AGREEMENT BETWEEN THE INTERNATIONAL ATOMIC ENERGY AGENCY AND THE GOVERNMENT OF THE UNITED KINGDOM OF GREAT BRITIAN AND NORTHERN IRELAND FOR THE APPLICATION OF SAFEGUARDS, VIENNA, DECEMBER 14, 1972. Treaty Series No. 23 (1973). London: Her Majesty's Stationery Office (1973). 8p.

The agreement is set out in parts: after the preamble stating the objects of the agreement, and a section on definitions there follows an undertaking by the Government not to use in such a way as to further any military purpose any nuclear material or facility while it is listed in the Inventory established by the Agency, and an undertaking by the Agency to apply its safeguards system to any such material or facility. The Parts concern: the Inventory; safeguards procedures; Agency inspectors; financial provisions; settlement of disputes; and provisions for amendment, entry into force and duration. (UK)

19438 ROLE AND ACTIVITY OF THE CENTRAL CONTROL LABORATORY IN THE CZECHOSLOVAK SAFEGUARDS SYSTEM. Zoch, O. (Atomic Energy Commission, Prague); Krivanek, M.; Krtil, J. Jad. Energ.; 20: No. 5, 147-154(May 1974).

The paper deals with organization of the safeguards system in the CSSR and duties of the Central Control Laboratory within the framework of this system. The tasks of the Laboratory are designed and its experimental equipment and capacity for the solution of the safeguards research problems are described. Further, some methods for the determination of nuclear materials are given, which have been used for the analyses of nuclear fuels at the Central Control Laboratory. (auth)

19439 SECURITY SEALS FOR SAFEGUARDS. Sastre, C. (Brookhaven National Lab., Upton, NY). Nucl. Technol.; 23: No. 2, 142-145(Aug 1974).

Security sealing systems for nuclear materials safeguards are based on tamper indicating and fingerprinted seals. The trend in fingerprinting development is based on random manufacturing process. A present design for fingerprinted seals uses an internally referenced optical alignment technique to provide unaided observation of a digital fingerprint. (auth)

19440 PORTAL MONITOR FOR DIVERSION SAFEGUARDS. Sampson, T. E.; Fehlau, P. E.; Worth, G. M.; Henry, C. N. (Los Alamos Scientific Lab., NM). Nucl. Technol.; 23: No. 2, 124-131(Aug 1974).

Two prototype doorway monitors to deter the diversion of special nuclear materials have been designed and constructed. One prototype utilizes plastic scintillators while the other contains NaI(Tl) detectors. Both prototypes utilize a unique digital, sliding interval, warning logic module. (auth)

19441 RECENT DEVELOPMENTS IN NUCLEAR FUEL CYCLE SAFEGUARDS. Bartels, W. C. (Atomic Energy Commission, Washington, DC). Nucl. Technol.; 23: No. 2, 101-105(Aug 1974).

New technology has been developed for nuclear material safeguards, in addition to the technology of nondestructive assay. New information on nuclear material shipments by truck supports efforts to provide a secure vehicle and radio communications system to improve the protection. Physical containment at fixed plant sites includes doorway personnel monitors to provide improved protection against covert removal of small quantities of nuclear material including plutonium and enriched uranium. Technology for better nuclear materials accountability and inventory verification includes sample dissolution techniques and automated spectrophotometric and titrimetric equipment enabling an analytical laboratory to increase the rate at which chemical analyses can be done for uranium and plutonium. Increased numbers of random samples will reduce ordinary uncertainties in accountability determinations due to random errors in individual measurements. (auth)

19442 SYSTEM FOR COMMUNICATIONS WITH COMMERCIAL SPECIAL NUCLEAR MATERIAL SHIPMENTS. de Montmollin, J. M.; Sellers, T. A. (Sandia Lab., Albuquerque, NM). Nucl. Technol.; 23: No. 2, 117-123(Aug 1974).

The Atomic Energy Commission (AEC) has recently implemented tighter security regulations governing special nuclear materials in transit. An objective of a continuous capability for communication with vehicles while en route is not attainable with the services now commercially available. Sandia Laboratories, a prime contractor to the AEC, is developing a system of wide-area communications tailored to the security needs of the carriers of nuclear materials. The system concept and the present status of development are described. (auth)

19443 DESIGN CONCEPTS STUDY OF A SPECIAL NUCLEAR MATERIAL CARGO VEHICLE. Reed, R. E. (Sandia, Lab., Albuquerque, NM). Nucl. Technol.; 23: No. 2, 112-116(Aug 1974).

Concepts were formulated to provide a basis for the design of a secure vehicle for surface transport of special nuclear materials. The design features are to provide for vehicle immobilization and penetration resistance consistent with U. S. Atomic Energy Commission requirements for increased protection against theft or diversion. The study includes objectives, parameters, and a preliminary estimate of cost. (auth)

19444 CHEMICAL ASSAY OF PLUTONIUM FOR SAFEGUARDS. Jackson, D. D.; Rein, J. E.; Waterbury, G. R. (Los Alamos Scientific Lab., NM). Nucl. Technol.; 23: No. 2, 132-141(Aug 1974).

The chemical measurement of plutonium in nuclear fuel cycle materials ranges from highly precise titrimetric methods applied to homogeneous products to less precise methods applied to heterogeneous scrap materials. A system under development for

analyzing scrap materials involves a combination of high-temperature pressurized acid-dissolution attack, a gamma assay for low levels of plutonium in any resulting residue, and an automated spectrophotometer for measuring plutonium in the liquid fraction. A review of chemical standards, that are essential for calibrating methods to maintain unbiased plutonium-assay measurements, indicates that a greater variety is needed for application to nuclear safeguards materials. (auth)

19445 URANIUM ASSAY REQUIREMENTS OF NUCLEAR ACCOUNTABILITY AND SAFEGUARDS. Bingham, C. D.; Lerner, M. W. (New Brunswick Lab., NJ). Nucl. Technol.; 23: No. 2, 106-111(Aug 1974).

Nuclear materials safeguards have spurred the development of faster, cheaper, and more reliable methods for the assay of uranium materials in the nuclear fuel cycle. These requirements have been met by an elegantly simple method suitable for both manual and automated operation. Dissolution of some samples remains a vexing problem, but some advances in this area are being made. Intra- and interlaboratory control programs are necessary to maintain the highest possible reliability of the analytical results. (auth)

19446 INFERNO FROM PORTFOLIO. Spiegel; 28: No. 4, 118-122(Jan 1974). (In German).

A study by the Ford Foundation, which reveals how easy it would be for extortioners to get fissionable material for explosive missiles is presented. It is concluded that safeguards for money are better than those for uranium and plutonium. (GE)

Disposal and Storage

Refer also to abstracts 18379, 18613, and 18636.

19447 (AECL-4707) AECL EXPERIENCE IN MANAGING RADIOACTIVE WASTES FROM CANADIAN NUCLEAR REACTORS. Morrison, J. A. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Mar 1974. 27p. Dep. NTIS (US Sales Only) $4.50. AECL $1.00.

The current status of radioactive waste from Canadian Nuclear Reactors is outlined in a description of waste management practice and experience at Chalk River Nuclear Laboratories where the majority of these wastes are stored today. The major policies which govern these operations, the principle of retrievability, and some future trends in the radioactive waste management field are discussed briefly. (auth)

19448 (CONF-740406-19) PLAN FOR RETRIEVAL OF SOLID LOW-LEVEL RADIOACTIVE PLUTONIUM WASTE AT NRTS. Hickman, W. W. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). [nd]. 45p. Dep. NTIS $5.25.

From second AEC pollution control conference; Albuquerque, New Mexico, USA (16 Apr 1974).

A Plan for Retrieval of Solid Low-Level Radioactive Plutonium (Alpha) Waste at the National Reactor Testing Station (NRTS) is discussed. The discussion deals with the descriptions, categories and volume of alpha wastes, experience gained in past alpha waste retrieval activities, the operations to be considered in the retrieval process, and conceptual designs of facilities and equipment required to retrieve alpha waste from the NRTS Burial Ground. (auth)

19449 (CONF-740434-5) ITSA: ABOVE GROUND RETRIEVABLE STORAGE METHOD FOR LOW-LEVEL TRANSURANIC WASTES. Macbeth, P. J.; Hickman, W. W. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). [nd]. 29p. Dep. NTIS $4.50.

From waste management symposium; Tucson, Arizona, USA (21 Apr 1974).

The storage method for low-level transuranic wastes employed at the Idaho Transuranic Storage Area (ITSA) is discussed in detail to show its effectiveness in meeting the requirements of AECM-0511. Storage costs of $1.04/ft^3 of waste are explained. The safety, efficiency and adequacy of this storage method are presented. (auth)

19450 TRANSPORTATION OF HIGHLY ACTIVE NUCLEAR WASTE PRODUCTS TO THE SUN. Reichert, R. G. (Dornier System GmbH, Friedrichshafen, Ger.). Astronautik; 10: No. 2, 157-160(1973). (In German).

The steadily increasing quantity of waste products from nuclear power stations makes it imperative to find suitable ways for the disposal of these products. Details of the transportation of the radioactive materials to the sun are discussed, giving attention to feasible launching and orbital conditions. Unmanned and manned spacecraft are considered, taking into account also a use of the space shuttle and the space tug. Waste-product disposal costs for a number of approaches are listed in a table. (IAA)

19451 CLOSED SYSTEM OF RADIOACTIVITY. Tokyo; Japan Atomic Industrial Forum, Inc. (1973). 34p.

In the face of an energy crisis and shortage of petroleum, human beings are compelled to utilize nuclear energy, based on the reuse of spent fuel and the rational disposal of nuclear wastes. This forms the closed system of radioactivity, which does not disrupt the environment. For the purpose, JAIF organized a council for Overall Measures on Nuclear Fission Products in August 1971. It is composed of three working groups: (1) utilization and development, discussing the strengthening of control measures and simultaneous expansion of the range of effective uses; (2) disposal, classifying the ways of final disposal into domestic and international solutions; and (3) deactivation, dealing especially with Sr-90, Cs-137 and Kr-85. The results of studies made by the council are presented, to give a comprehensive picture for further studies on the worldly problem. (JA)

Handling Equipment and Procedures

Refer also to abstract 20448.

19452 (JAERI-M-5599) INERT-ATMOSPHERE GLOVEBOX FOR HANDLING PLUTONIUM CARBIDE FUEL. Fukushima, S.; Sasayama, T.; Suzuki, Y.; Watanabe, H. (Japan Atomic Energy Research Inst., Tokyo). Mar 1974. 43p. (In Japanese). NTIS (US Sales Only).

An inert atmosphere glovebox for handling uranium-plutonium mixed carbide fuel was designed and constructed. It consists of the stainless steel box with four pairs of glove ports and a vacuum airlock, an inert gas purifier, a gas circulation system, oxygen and water vapor measuring devices, an automatic pressure control system, and a safety alarm system. The apparatus is maintained at negative pressure to prevent the leakage of plutonium. Purity of argon gas depends on leakage of the glovebox and also performance of the purifier. A nickel catalyst bed and a molecular sieve bed are used to remove oxygen and moisture, respectively. The oxygen and water vapor concentrations in the inert atmosphere are held at 1 ppM at a circulation rate of 20 box-volumes/hr. The gas pressure in the glovebox is controlled at -30 ± 20 mmAq during normal operation. (auth)

19453 REMOTE VIEWING EQUIPMENT FOR HOT CELLS. Review. Bychkov, O. D. (Comp.). At. Tekh. Rubezhom; 9: 31-36(Sep 1973). (In Russian).

A description and the technical characteristics of a series of remote viewing equipment for hot cells, made by Kollmorgen (USA) and Union Optics (Japan) are presented. (tr-auth)

19454 EFFECT OF POSITION IN THE CRITICALITY OF URANIUM SPHERES IN URANIUM SOLUTION CYLINDERS. Rothe, R. E.; Hunt, D. C. (Dow Chemical Co., Golden, CO). Nucl. Sci. Eng.; 54: No. 3, 360-366(Jul 1974).

Thirteen previously unpublished critical measurements on enriched (93.16 wt% ^{235}U) uranium metal spheres, which are radially but not axially centered in cylinders of enriched (93.16 wt% ^{235}U) uranium solution, are presented and compared with the results of Monte Carlo calculations. The average reproduction factor calculated for experimentally critical systems was k = 0.989, and this bias showed no systematic variation with the amount the sphere was displaced from center. The sphere size was increased, keeping other parameters constant, until criticality was calculated, at which point the average sphere radius and mass were 2.8 and 8.8%, respectively, greater than the experimental cases. For a given solution cylinder, the minimum critical metal sphere mass occurs when the sphere is centered in the solution. The increase in this critical mass with position along the cylinder axis is also presented parametric in two tank diameters and five solution concentrations. For like asymmetries and at the same concentration, a greater change in the critical sphere mass with position is seen for tanks of large diameter than for smaller tanks. If the tank diameter is fixed, the greater change occurs for solution of high uranium concentration. (auth)

19455 CALCULATIONS ON RASCHIG-RING-POISONED PLUTONIUM SOLUTION SYSTEMS USING HANSEN-ROACH CROSS SECTIONS. Nucl. Sci. Eng.; 54: No. 3, 367-368(Jul 1974).

The suitability of Hansen-Roach cross sections for criticality calculations on plutonium nitrate solutions in Raschig ring-filled tanks is discussed. (TFD)

19456 REMOTE HANDLING EQUIPMENT IN RADIOCHEMICAL INSTALLATIONS. Lefort, G. (CEN, Fontenay-aux-Roses, France); Faudot, G.; Sontag, R.; Calame-Longjean, A. Bull. Inform. Sci. Tech. (Paris); No. 189, 43-65(Feb 1974). (In French).

The specific requirements of radiochemical installations for research and development in the field of irradiated fuels and transuranic elements are different from those of other active

installations. The different factors which must be taken into consideration in the design and utilization of such installations are discussed together with the principal ways in which difficulties are overcome: shielded and/or contained enclosures provided with master–slave remote, handling equipment or power handling equipment for normal operation or remote maintenance. Maintenance, decontamination, transformation, operational safety, and personnel training problems are also discussed. Descriptions are given of the remote handling equipment of three important facilities of the Chemistry Division. (FR)

19457 SIMPLIFIED METHODS OF ESTIMATING THE RESULTS OF ACCIDENTAL SOLUTION EXCURSIONS. Tuck, G. (Dow Chemical Co., Golden, CO). Nucl. Technol.; 23: No. 2, 177-188(Aug 1974).

Simplified methods of estimating the results of accidental solution excursions in tanks have been developed. With these methods, an estimate of the number of fissions in the burst, total fissions, or maximum power level can usually be obtained with a desk calculator. The equation parameters are tank diameter, height, and fill rate. The fissile material concentration is not required since, in each case, the "worst-case" concentration was assumed in the derivation of the equation. These methods are sufficiently accurate for most calculations required for safety analysis reports and process plant design. The severity of an excursion can be limited by several methods which include criticality alarm activated shut-off valves in the feed lines, remote tank drain capability, minimizing tank size, etc. (auth)

19458 SURFACE DENSITY METHOD EMPLOYING UNIT SHAPE FACTOR (s/v) FOR THE STORAGE OF FISSILE MATERIALS. Schuske, C. L.; Dickinson, D.; Altschuler, S. J. (Dow Chemical Co., Golden, CO). Nucl. Technol.; 23: No. 2, 157-176(Aug 1974).

Models for the safe and economical storage of large quantities of plutonium or highly enriched uranium have been developed. The models cover a wide range of compositions from aqueous solutions, wet and dry oxides, to full density metals. The models all use the parameters of unit surface-to-volume ratio and array surface density to define the safe storage arrays. The models take account of unit shape, size, and composition, as well as vault size. Arrays containing a mixture of different units are easy to calculate by the model. Important accident situations, such as double batching and fissile solution spills, are considered. (auth)

Transportation

Refer also to abstract 19450.

19459 (LA-5526-MS) SHIPPING CASK FOR FAST REACTOR FUEL ELEMENTS. Noyes, H. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Jan 1974. Contract W-7405-eng-36. 74p. Dep. NTIS $5.45.

A well-shielded shipping container weighing approximately 12,500 lb has been designed to accommodate irradiated fuel pins up to 40 in. in length in support of the Liquid Metal Fast Breeder Reactor Program. Having attained a burnup of 10 at. %, with increased irradiation exposure and corresponding increase in temperature, it is important that some fuel elements be shipped in a vertical position. In compliance with existing regulatory requirements, the background material and approvals are given in appendixes. (auth)

19460 (REG/G-5.31(6-74)) SPECIALLY DESIGNED VEHICLE WITH ARMED GUARDS FOR ROAD SHIPMENT OF SPECIAL NUCLEAR MATERIAL. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jun 1974. 3p. DRS.

This guide describes features acceptable to the Regulatory staff for a vehicle operated by armed guards to ship special nuclear material by road and for the qualification of the armed guards. (TFD)

19461 (REG/G-5.32(6-74)) COMMUNICATION WITH TRANSPORT VEHICLES. (USAEC Directorate of Regulatory Standards, Washington, D. C.). Jun 1974. 6p. DRS.

This guide describes radiotelephone equipment and systems, and procedures for their use, that are acceptable to the Regulatory staff for complying with the Commission's regulations regarding radiotelephone communication in connection with road or rail shipments of special nuclear material. (TFD)

19462 (SLA-74-5374) ANALYSIS OF TRANSPORTATION ACCIDENT ENVIRONMENTS: THE PURPOSE, METHOD, AND INTRODUCTION. Hartman, W. F.; Clarke, R. K.; Larson, D. W.; Foley, J. T. (Sandia Labs., Albuquerque, N. Mex. (USA)). [nd]. 10p. (CONF-740901-7). Dep. NTIS $4.00.

From fourth international symposium on packaging and transportation of radioactive materials; Miami Beach, Florida, USA (22 Sep 1974).

This paper serves as an introduction to three papers which deal with the characterization of the severity of the environments to which cargo will be subjected in aircraft, motor vehicle, and railroad transportation accidents. (TFD)

19463 (WASH-1313) PROCEDURES FOR PICKING UP AND RECEIVING PACKAGES OF RADIOACTIVE MATERIAL. (USAEC Directorate of Regulatory Standards, Washington, D.C.). Jun 1974. 34p. Dep. NTIS $4.00.

Information is presented on the requirements and procedures for: receiving packages of radioactive material or notification of their arrival; expeditious pickup of packages; monitoring of packages received; notification of excess external radiation detected on package; recording of monitored data; and instrumentation involved in monitoring. (LCL)

19464 TRANSPORT OF RADIOACTIVE MATERIALS BY THE CEA. Labrousse, M. (CEA, Chatillon, France). Bull. Inform. Sci. Tech. (Paris); No. 190, 5-14(Mar 1974). (In French).

Since the publication, in 1967, of articles devoted to the transport of radioactive materials, an important evolution has taken place, bearing both on the nature of the transport—where natural uranium hexafluoride, irradiated fuel, and wastes are becoming comparatively more important than miscellaneous small packages—and the construction of packagings, which are becoming more and more elaborate. This evolution is presented. (FR)

19465 NEW LEGISLATION ON THE TRANSPORT OF RADIOACTIVE MATERIALS. Cohendy, G. (CEA, Chatillon, France). Bull. Inform. Sci. Tech. (Paris); No. 190, 15-19(Mar 1974). (In French).

The transport of radioactive materials is governed by National Regulations, which are in fact part of the Regulations for the Safe Transport of Dangerous Materials; this part is called Class IVb. These Class IVb Regulations are directly inspired by the IAEA Regulations for the Safe Transport of Radioactive Materials. These Regulations are revised periodically by a panel of experts of the countries concerned in the light of the accumulated operating experience. The latest revision has been carried out in 1973 and the French regulations have been brought up to date according to these regulations. The main differences between the requirements of the previous regulations and those of the new regulations are reported. (FR)

19466 CRITICALITY-SAFETY IN FISSILE MATERIAL TRANSPORTATION. Haon, D. (CEN de Saclay, Gif-sur-Yvette, France); Leclerc, J.; Labrousse, M. Bull. Inform. Sci. Tech. (Paris); No. 190, 21-28(Mar 1974). (In French).

After a short recall of basic criticality concepts, a survey is given of the nuclear safety requirements specified by the regulations and of the spirit whereby the criticality safety problems in fissile material transportation are resolved. An account of calculation methods is given and some packaging designs were studied. (FR)

19467 CARRYING OUT OF TESTS APPLICABLE TO PACKAGES FOR RADIOACTIVE MATERIALS. Remy, J. (CEA, Chatillon, France). Bull. Inform. Sci. Tech. (Paris); No. 190, 29-45(Mar 1974). (In French).

Incidents and accidents to which packages may be exposed during transport are figured by tests determined by the International Atomic Energy Agency. After reviewing the nature and purpose of these tests, a description of the CEA test station is given, and the carrying out of the tests is considered with a special stress on the scale model testing method. (FR)

19468 DISPOSABLE PACKINGS FOR RADIOELEMENTS. Vinarnick, L. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. (Paris); No. 190, 55-61(Mar 1974). (In French).

The disposable packings as presently dispatched by the Department des Radioelements are described together with the items on which changes are to be expected; a glimpse on some problems related with the number and variety of the shipments is given. (FR)

19469 DEVELOPMENT OF SAFETY TECHNIQUES FOR THE TRANSPORT OF RADIOACTIVE MATERIALS. Sousselier, Y. (CEA, Chatillion, France). Bull. Inform. Sci. Tech. (Paris); No. 190, 63-67(Mar 1974). (In French).

The validity of the tests carried out on radioactive material packaging is discussed. Two problems were studied: radiation hazards for the population during transport under standard conditions; and testing of Type B packagings. The development of safety techniques is examined. (FR)

19470 PACKINGS FOR THE TRANSPORT OF IRRADIATED FUELS FROM FAST REACTORS. Labrousse, M.; Lucas, H.

(CEA, Chatillon, France). Bull. Inform. Sci. Tech. (Paris); No. 190, 47-54(Mar 1974). (In French).

The Rapsodie and Fortissimo fuel pins, irradiated at Cadarache, are being reprocessed at La Hague. The CEA has some experience in transport of irradiated fuel from fast breeder reactors. After a short description of IU 07 packaging design used for this purpose, the report mentions the problems raised by the transport of the Phenix reactor pins and the choice made between possible alternatives for the construction of IU 11 packaging. The progress of the first studies carried out for the transport of Super Phenix assemblies is presented. (FR)

19471 APPARATUS FOR SELECTIVELY TRANSPORTING FUEL ELEMENTS. Jones, C. R. (to Transfer Systems Inc.). US Patent 3,823,065. 9 Jul 1974. Filed Date 7 Sep 1971. 8p.

A nuclear fuel assembly in which vertically disposed fuel elements are spaced within a housing generally of a rectanguloid configuration is described. Each fuel element includes an upper end plug and lower end plug. Vertically spaced support plates are disposed in the housing with suitable openings to receive the upper and lower end plugs of the fuel elements for supporting the fuel elements with the housing. The upper plate is removable from the housing and the lower plug is detachably connected to the lower plate. A grapple having lifting plates with pins enter recesses formed in the housing for enabling the housing to be raised. After the fuel assembly is raised by the grapple, leaf spring retainers of the upper plate are dislodged for removing the upper plate from the housing. Now, the fuel elements can be removed selectively and individually from the fuel assembly by a removal tool. Aligned with and disposed above the removal tool is a transfer casing for housing the selective removal fuel element while the selectively removed fuel element is transported to and from a fuel reprocessor. (Official Gazette)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstract 19869.

19472 (AED-Conf-74-042-011) POLARIZED PARTICLES IN THE GIESSEN 1.2 MeV TANDEM ACCELERATOR. Berg, H. 1974. 14p. (In German). INIS.

From spring meeting of the working group "Nuclear and high-energy physics" of the Deutsche Physikalische Gesellschaft e.V.; Bochum, F. R. Germany (4 Mar 1974).

14 figs. With abstract.

An account of the present state of the project "Polarized particles in the Giessen 1.2 MeV tandem accelerator" is given. At present, 310 nA H^- with a polarization of 0.64 ± 4% can be achieved with the Giessen Lambshift source in continuous operation, or 500 nA H^- with a polarization of 0.61 ± 4%. In charge exchange experiments using a gas electrode, a current of 300 nA protons has been achieved in continuous operation, and 400 nA protons as a peak value. Charge exchange using a carbon foil yielded approximately 30 nA protons at the target with a polarization of 0.64 ± 4%. (GE)

19473 (ANCR-1154) PRODUCTION OF 14-MeV NEUTRONS BY HEAVY IONS. Brugger, R. M.; Young, R. C.; Miller, L. G. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). May 1974. Contract AT(10-1)-1375. 8p. Dep. NTIS $4.00.

A 14-MeV neutron source is described. This source is based on accelerating heavy ions into a mixture of deuterium and tritium. The heavy ions will produce recoil deuterons and tritons which will interact with atoms of the tritium or deuterium to produce 14-MeV neutrons. (auth)

19474 (BNL-18944) SHOULD PROTONS BE ACCELERATED IN SUPERCONDUCTING STORAGE RINGS? Month, M.; Lee, Y. Y. (Brookhaven National Lab., Upton, N. Y. (USA)). 20 May 1974. 10p. Dep. NTIS $4.00.

It has always been taken as obvious that it is an advantage to have protons available for injection at the peak operating field of storage rings. However, this may not be valid if one takes into consideration the heating of the superconducting coils by "lost" protons. To achieve the maximum energy, the magnets should be operated near the critical field, with as small temperature reserve as possible. On the other hand, losses during injection and stacking make it desirable to have a large temperature reserve. Both these requirements on temperature reserve are accommodated by an operating mode in which the stack is accelerated in the storage ring. The relationship of the injection energy to the temperature reserve and to the energy deposition by protons and thence to the amount of tolerable "fast loss" protons at injection is considered. (auth)

19475 (INIS-mf-1168/2, pp vp 32p) WHAT CAN BE DONE WITH A SMALL ACCELERATOR. Hjort, S. A. (Research Inst. for Physics, Stockholm). 1973.

From Finnish summer school in nuclear physics, 1973; Liperi, Finland (11 Jun 1973).

It is defined, what is meant by a small accelerator. The level of ambition of the research is discussed and the various applications in the different fields of physics are mentioned and discussed. A few remarks concerning the organization of the laboratory and the politics of the research are included. (INIS)

19476 (ORNL-3324) Mc^2 ISOCHRONOUS CYCLOTRON. A Status Report. (Oak Ridge National Lab., Tenn. (USA)). 15 Jun 1962. Contract W-7405-eng-26. 163p. Dep. NTIS $11.25.

The status of design studies for the Mc^2 Cyclotron, a high-energy proton accelerator, is reviewed. The cyclotron, an isochronous machine with an eight-sector spiral magnet configuration, would provide a maximum beam energy of 900 MeV. An extracted beam of 100 microamperes at an energy of 810 MeV is planned. Three large shielded experiment rooms with a total area of 24,000 ft are arranged so that several experiments can be set up simultaneously; also, multiple beams can be used with a minimum of mutual interference. The report reviews the following: secondary beams; research programs; experimental area; operation of Cyclotron Analogue II, (the electron model of the Mc^2 Cyclotron); cyclotron design and specifications; magnetic field design; accelerating system; residual radioactivity; shielding; building design; and accelerator research and development. The appendices include: site selection; personnel requirements; tentative scope and cost; and a suggested schedule for design and construction. (auth)

19477 (SUNI-28) ANNUAL RESEARCH REPORT, 1973. McMurray, W. R. (Comp.). (Southern Universities Nuclear Inst., Faure (South Africa)). 1973. 83p. Dep. NTIS (US Sales Only) $7.25.

A status report on the 5.5-MV van de Graaff accelerator is given first. The section on nuclear structure and dynamics includes neutron-induced reactions; (p, n) reactions; levels, spins, lifetimes, and decay properties using inelastic scattering and capture reactions; model calculations; and heavy-ion reactions. The section on nuclear chemistry includes backscattering analysis, elemental determination, computer simulation of radioactive decay, and molecular effects in channeling, with emphasis on elemental analysis by charged particle-induced x rays. Applications of nuclear techniques include applications in the medical field, sediment and water dispersion studies, and applications in industry. Sections on beam-foil spectroscopy, Atomic Energy Board units, publications and reports, and staff are also included. Twelve of the papers in this report are title listed separately. (RWR)

For abstracts of individual papers see: 18165, 18206, 20008, 20009, 20059, 20075-20077, 20093, 20094, 20117, and 20188.

19478 NEPTUNE: A 6-MeV MEDICAL ACCELERATOR. Azam, G. (Compagnie Generale de Radiologie, Paris). Rev. Tech. Thomson-CSF; 5: No. 3, 669-701(Sep 1973). (In French).

Having broadly described the present position with regard to radiotherapy problems and pointed out the main differences between an accelerator like the Neptune and cobalt apparatus, the operating principle and performance characteristics of the Neptune are described. The accelerator capabilities are examined, such as irradiation with a photon or electron beam, arc-therapy, automation and (with a few minor modifications) its conversion into an industrial type radiography device. (FR)

19479 PRESENT STATUS OF ACCELERATORS OF HEAVY IONS AND THE EXAMPLES OF THEIR APPLICATION TO VARIOUS FIELDS. Odera, M. (Inst. of Physical and Chemical Research, Wako, Japan). Oyo Butsuri; 42: No. 2, 80-96(Feb 1973). (In Japanese).

Present status of the accelerators of heavy ions are reviewed and future prospects are briefly discussed. Several examples of application of these accelerators in various fields of research are given in relation to the description of interaction of heavy ions with matter. (auth)

19480 TONUS: A NANOSECOND RELATIVISTIC ELECTRON ACCELERATOR. Gleizer, I. Z.; Didenko, A. N.; Dronova, L. P. At. Energ. (USSR); 36: No. 5, 378-382(May 1974). (In Russian).

A description is given of the design and results obtained during the first eight months of operation of TONUS, a high-current, nanosecond electron accelerator consisting of a Marx pulse generator, Blumlein pulse-forming line, multi-channel gas commutator and electron gun. A pulse generator of 2.2 MV maximum voltage has 20 condenser stages (200 condensers) and 11 spark gaps. The outer electrode of the Blumlein line is a steel pipe, of 1.2 m diameter and 5.3 m length serving as the accelerator housing. Insulators of organic glass are used to suspend the electrodes to the line in the housing. The impedance of the Blumlein line is 24 ohms. The charging voltage from the pulse generator is fed to the central electrode of the Blumlein line via a porcelain insulator. Transformer oil (total weight ~8 tons) is used to fill the accelerator housing. The line commutator consists of four parallel 3-electrode spark gaps with the ignition gap at the central electrode. The stability of gap firing is within 2 ns. A multiple-needle field emission cathode is used to provide stable kiloampere currents. (auth)

19481 ENGINEERING FOR PHYSICS. A Progress Report on the Nuclear Structure Facility at the Daresbury Laboratory. Voss, R. G. P. (Science Research Council, Daresbury, Eng.). Phys. Bull. (London); 25: 228-229(Jun 1974).

In 1971 a design study, which was at the same time a feasibility study, was started at Daresbury Laboratory UK for an accelerator which would operate initially at a terminal potential of 20 MV and be capable of upgrading to 30 MV. In parallel with the design study considerable effort was put into an associated research and development programme. The accelerator is described and the R and D program, aimed at obtaining a deeper understanding of these machines and their component parts, is considered. Construction of the facility is now under way, and many of the major items are being ordered. Many components will have to be manufactured and assembled within the laboratory, and appropriate facilities are being set up. The time scale for construction is 4½ years so that provided present delays in supplies do not worsen the facility will be operational in the second half of 1978. (UK)

Auxiliaries and Components

19482 (KHFTI-72-8, pp 119) PROBLEM OF THE LUE-2 LINEAR ELECTRON ACCELERATOR AUTOMATIZATION. Boriskin, V. N.; Makarov, A. F.; Yamnitskii, V. A. 1971. (In Russian).

The problems in the use of a computer for the complex automation of the 2-GeV electron linear accelerator are examined. The complex automation provides for the creation of a technical basis of the automation means and calculational techniuqes, development of mathematical quarantees for the acquisition and processing of data from the system and accelerator subunits, the creation of control algorithms on the basis of the acquired and processed data, and its realization in the form of controlling computer programs. The results achieved in the complete automation are reported. A system for the acquisition of data in which the Dnepr-22 computing complex is introduced was designed and tested. Also designed and tested were the Dnepr-22 controlling complex, a real switch for the transmitter into 7 inlets, a circuits for the conversion and distribution of data based on the AI-128 amplitude analyzer, and a teletype connection of the accelerator dispatcher with the Dnepr-21 computer. (tr-auth)

19483 (KHFTI-72-8, pp 122-124) SOME RESULTS OF THE ACCELERATOR SYSTEM INVESTIGATION. Boriskin, V. N. 1971. (In Russian).

The results of the measurements of the time distribution of the current amplitudes of the accelerator and of the field intensity of charged and uncharged sections of the linear electron accelerator are reported. On the basis of the measurements reported a plan was formulated for studies on the accelerator systems using the "Dialog" program. The proposed study was directed to the determination of the possibility of the creation of an algorithm for accelerator control using the Dnepr-2 controlling digital system. (tr-auth)

19484 (KHFTI-72-8, pp 124-125) MONITORING AND CONTROL OF THE WAVE PHASE IN THE ACCELERATING SECTION OF AN ELECTRON LINEAR ACCELERATOR. Grishaev, I. A.; Dem'yanenko, G. K.; Kolosov, V. I.; Kransikov, V. D.; Mel'nichenko, V. V.; Nikitina, T. F. 1971. (In Russian).

A method is described for the monitoring and control of the wave phase based on the effect of the charging of the beam of the waveguide accelerating structures. A phase control algorithm was developed by the method of comparison of two values $|\dot{E}'_p|$ and $|\dot{E}|$. The basic parameters of the energy spectra corresponding to the cases of accelerator phasing by the customary method and during verification of the algorithm by the method of comparison of $|\dot{E}'_p|$ and $|\dot{E}|$ are given. A comparison of the data showed that accelerator phasing on the basis of the algorithm developed guarantees a defined precision of the establishment of the optimum phases and can be the basis for the automatic phasing of sections by means of the Dnepr-2 digital computer. (tr-auth)

19485 (KHFTI-72-8, pp 130-132) MEMORIZING CIRCUIT FOR AMPLITUDE VALUES OF THE ELECTRON LINEAR ACCELERATOR PULSE VOLTAGE TRANSMITTERS. Yamnitskii, V. A. 1971. (In Russian).

A storage circuit for the amplitude values of the pulse signals (duration no more than 0.4 msec) in a time of 16 to 18 msec, i.e., at practically all time intervals between accelerator transmissions, is described. The use of such a circuit in a series of channels makes it possible by means of analog-digital converters (components of the controlling complex Dnepr-22) to examine from 8 to 15 pulse transmitters from one transmission of the accelerator. A time diagram of the operation of the circuit is given. (tr-auth)

19486 (L-Ueb-180) CALCULATION OF THE TOLERANCE FOR THE MAIN PARAMETERS OF THE DAMPING MAGNET AT THE EREVAN SYNCHROTRON. Kovalenko, V. I. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). 1974. 16p. (In German). INIS.

4 figs.; 1 tab. Translation of the Russian EFI-28(73).

Studies performed on the Erevan synchrotron have led to the definition of a concrete design of the damping magnet with alternating field polarity for the damping of betatron oscillations. The design is discussed in detail along with a calculated tolerance system for the magnet's parameters. (GE)

19487 (L-Ueb-181) CALCULATION OF THE MOST IMPORTANT PARAMETERS OF THE DAMPING MAGNETS FOR THE EREVAN SYNCHROTRON. Esin, S. K.; Kovalenko, V. I. (Deutsches Elektronensynchrotron (DESY), Hamburg (F. R. Germany)). 1974. 16p. (In German). INIS.

4 figs.; 2 tabs.; 9 refs. Translation of the Russian EFI-11(72).

The intensity of the radiation of the electrons moving within the accelerating field is the most outstanding feature of the electron ring accelerator. This radiation can be used to achieve a damping of radial betatron oscillations (as a result of the weakening of the damping of phase oscillations), which is of importance with regard to a uniform, slow alignment of the high-energy electrons. Two interesting methods are applicable in electron synchrotrons to achieve a damping of these radial oscillations, namely a method involving field changes and the resonance method. Since these two damping methods have not yet been fully investigated and experimentally verified to assess their respective advantages and disadvantages, this paper presents the results of calculations for the definition of the most important parameters of damping magnets to be used in the study of the two methods. (GE)

Ion Sources and Injection and Extraction Systems

19488 (AED-Conf-74-085-007) AN ELECTRON BEAM ION SOURCE FOR THE PRODUCTION OF MULTICHARGED HEAVY IONS. Clausnitzer, G.; Klinger, H.; Mohr, R.; Mueller, A.; Salzborn, E. 1974. 7p. (In German). INIS.

From spring meeting of the Deutsche Physikalische Gesellschaft e.V., its expert committees on: atomic physics, pulse physics, molecular physics, plasma physics; Stuttgart, F. R. Germany (4 Mar 1974).

6 figs.

An electron beam ion source for the production of multicharged heavy ions is described. A measured charge spectrum — typical of successive, progressive ionization — with a maximum at fourfold charge is interpreted in terms of model calculations. (GE)

19489 (BNL-tr-568) 20-mA INJECTOR OF H^- IONS. Dimov, G. I.; Roslyakov, G. V. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). [nd]. Translation by S. J. Amoretty of IYAF-56-73. 7p. Dep. NTIS $4.00.

To increase the current of the proton beam injected by the charge-exchange method into one of the storage rings at Novosibirsk, the EG-1.5 electrostatic accelerator was equipped with a charge-exchange H^- ion source. The H^- ion beam at the accelerator output was 20 mA at 1 MeV and a pulse duration of 200 μsec. A diagram of the ion source is given. (WHK)

19490 (IFVE-SKU-73-27) PROTON EJECTION FROM THE 70-GeV ACCELERATOR FOR LIQUID HYDROGEN BUBBLE CHAMBER "LUDMILA" (S EJECTION). Aseev, A. A.; Drozhdin, A. I.; Zelenov, B. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1973. 28p. (In Russian). INIS.

The results of study on the ejection of a proton beam from the 70-GeV IFVE accelerator for the "Ludmilla" liquid hydrogen chamber are discussed. The characteristics of the beam ejection and transport systems, the calculated parameters, tolerances, and the characteristics of the equipment are discussed. A method for aligning the system and the apparatus used is described, and the results of tuning the system are reported. (tr-auth)

Ion Optics and Field Calculations

19491 (KFK-tr-443) LIMITATIONS OF THE EFFECTIVE FIELDS IN ELECTRON-RING ACCELERATORS. Makhan'kov, V. G.; Meshcheryakov, M. G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Literaturabteilung). Oct 1973. 7p. (In German). INIS.

5 refs. Translation of the Russian report JINR-P9-7261.

Limitations of effective accelerating fields, i.e. the energy increment per m, in electron-ring accelerators due to instabilities in the electron ion rings within the region of pre-critical and supercritical electron numbers in the ring, are discussed. (GE)

19492 (KFTI-73-5) CALCULATION OF CHARGED PARTICLE BEAM TRANSPORT SYSTEM. Development of Energetic Resolution of System with Parallel Transfer of Electron Beam at Electron Linear Accelerator. Chkalov, I. I.; Makhnenko, L. A.; Rubtsov, K. S.; Khvastunov, V. M.; Shevchenko, N. G. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1973. 52p. (In Russian). INIS.

A matrix method for calculating a system for moving a beam of charged particles is described. The magnet system, which consists of magnets and quadrupole lenses with a nonhomogeneous magnetic field, can be calculated to approximately a second order. The method is used to calculate a system of parallel transport of an electron beam at the outlet of a linear accelerator in order to

improve its energy resolution. In the calculations a focusing arrangement of the "point dimension" type was used. The system was modified in accordance with the calculations. Experimental data showed an improvement in the resolution from 0.6 to 0.2%, which agrees well with calculations. (tr-auth)

19493 (KHFTI-72-8, pp 64-76) USE OF THE LIGHT PENCIL IN STUDIES ON BEAM DYNAMICS IN LINEAR ACCELERATORS AND BEAM TRANSPORT SYSTEMS. Artemov, V. I.; Grishaev I. A.; Gugel, I. N.; Dovbnya, A. N.; Kolot, Z. M.; Kornienko, E. V.; Mocheshnikov, N. I. 1971. (In Russian).

The program using a light pencil, developed at the Physics-Technical Institute, for the purpose of carrying out operational calculations of beam dynamics is described. The mathematical model of the accelerator and the principles of its control are discussed. The program with the light pencil was used for the calculation of beam dynamics in the multisection 2-GeV linear accelerator. The simulation of the different regimes of the linear electron accelerator showed the high effectiveness of the use of the computer in combination with a light pencil. Since a description is given in the program of all standard focusing devices, it can be used for the calculation of any system for beam transport. (tr-auth)

19494 (LA-tr-74-21) SOME STUDIES OF OPERATION OF THE I-2 LINEAR ACCELERATOR FOR OUTPUT BEAM CURRENT UP TO 200 mA. Development of New Technological Apparatus (1972). Kapchinskii, I. M.; Batalin, V. A.; Lazarev, N. V.; Bobylev, V. I.; Kartsev, L. V.; Kolomiets, A. A.; Kozodaev, A. M.; Koloskov, V. V.; Kuibida, R. P.; Edemskii, V. I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). Jun 1974. Translation by H. J. Dahlby of ITEF-106. 41p. Dep. NTIS $5.25.

Some results are given of an experimental investigation of the beam dynamics in the I-2 linear accelerator, the injector of the proton synchrotron of the Institute of Theoretical and Experimental Physics (ITEP), carried out in 1972 for an output beam current up to 200 mA. Also, descriptions are given of improvements to the accelerator. (auth)

19495 (UJF-2987) AVERAGE VALUE OF THE MAGNETIC FIELD IN A ISOCHRONOUS CYCLOTRON. Kuzmiak, M.; Straka, J.; Hrda, A. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). Jun 1973. 10p.

The average value of the magnetic field of an isochronous cyclotron was calculated. A differential equation for the departure of the ion trajectory from the reference circle was solved, starting from the motion equation in the median plane of the isochronous magnetic field. (Nuclear Sci. Abstr. Czech.)

19496 SIMPLE INEXPENSIVE BENDING MAGNET SYSTEM FOR VERY LOW ENERGY ION BEAMS. Ward, T. R.; Jiggins, A. H. (Polytechnic of the South Bank, London). J. Phys., E (London); 7: No. 7, 520-521(Jul 1974).

A small electromagnet system with circular plane-face 38 mm diameter pole pieces is described which bends 400 keV protons or deuterons through 7½° and separates them cleanly from unwanted beam components. It costs £300, which is under one-fifth the price of a conventional arrangement. (auth)

19497 STABILITY OF OSCILLATIONS OF FINITE AMPLITUDE IN ELECTRON-ION RINGS. Berman, G. P. Zh. Prikl. Mekh. Tekh. Fiz.; No. 3, 170-172(1974). (In Russian).

The transverse oscillations of finite amplitude in electron-ion rings are examined. At a distance from the region of linear resonance, an equation was obtained for the slowly changing amplitude and the conditions for the excitation of instabilities of the "negative pressure" type are determined. Near the lower boundary of the region of linear instabilities, conditions were found at which the non-linearity eliminates the stability of the finite-amplitude oscillations. (tr-auth)

19498 PHASE SELECTION MECHANISMS IN ISOCHRONOUS CYCLOTRONS PRODUCING HIGH RESOLUTION BEAMS. Collins, J. C. East Lansing, MI; Michigan State Univ. (1973). 130p. University Microfilms Order No. 74-13,880.

Thesis (Ph. D.).

Phase selection utilizing coupling between radial and longitudinal motion has long been a useful tool at the Michigan State University Isochronous Cyclotron for producing very high energy-resolution beams. A study was undertaken to obtain a better understanding of this phenomenon by identifying the relevant machine parameters and their quantitative effects. While the M. S. U. machine provides a convenient prototype cyclotron, our results are not confined to this one example as various dee angles and magnetic field structures are investigated. Other parameters of importance are dee voltage, acceleration harmonic and phase history. The role of orbit centering is given particular attention, especially as it relates to the difference between actual phase histories and those from the standard M. S. U. field trimming program. Most orbit calculations were done with a precise numerical integration code limited only by the assumption of step function energy gain. Finally, the data are used to discuss the general problem of placement and effectiveness of phase selection slits. (Diss. Abstr. Int., B)

19499 PROPERTIES OF ION ORBITS IN THE CENTRAL REGION OF A CYCLOTRON. Louis, R. J. Vancouver, B. C.; Univ. of British Columbia (1971). 215p.

Thesis.

The behaviour of ion orbits in the magnetic and electric fields at the centre of a cyclotron is studied in detail. A numerical method for calculating these fields is examined in detail. The method is suitable for complicated electrode shapes and converges rapidly, yielding potentials in three dimensions with average errors of less than 0.01%. The magnetic fields used in the orbit calculations are measured on model magnets. Both axial and radial motion are investigated. The geometry of the orbit on the first turn is discussed in detail. The problems associated with using a three-fold symmetric magnetic field with a two-fold symmetric electric field are also discussed. Besides the well-known gap-crossing resonance, a previously ignored phase-oscillation effect is found to be important for cyclotrons operating on a high harmonic of the ion rotation frequency. (MGH)

19500 DESIGN OF ELECTROMAGNETIC LENSES OF COMPLEX CONFIGURATION. Sventitsakaya, I. N. Sov. J. Opt. Technol.; 40: No. 7, 421-424(Jul 1973).

Translated from Opt.-Mekh. Prom.; 40: No. 7, 23-25(Jul 1973).

Methods that reduce the computational error in the case of mathematical instability arising in the determination of the field of complicated electrode systems are discussed. Linear programming is one such method. Specific examples of calculated electron optics systems are given. (auth)

19501 GEOMETRICAL ABERRATION OF PSEUDOSTIGMATIC QUADRUPOLE DOUBLETS FED ASYMMETRICALLY. Gyula, S. ATOMKI (At. Kut. Intez.) Kozlem.; 16: No. 2, 165-173(1974). (In Hungarian).

The geometrical aberration coefficients of electrostatic and magnetic quadrupole doublets fed asymmetrically are given in the "weak lens" approximation. Though a quadrupole doublet fed asymmetrically is never free from aberrations due to asymmetrization, some aberration coefficients can become zero, choosing the asymmetry parameters of the two lenses suitably. This leads to a decrease in the broadening of the beam because of the asymmetrization. (auth)

19502 FOURTH-ORDER PERTURBATION CHARACTERISTIC FUNCTION OF QUADRUPOLE LENSES FED ASYMMETRICALLY AND GEOMETRICAL ABERRATION COEFFICIENTS IN WEAK LENS APPROXIMATION. Gyula, S. ATOMKI (At. Kut. Intez.) Kozlem.; 16: No. 2, 147-164(1974). (In Hungarian).

Some results of the investigation on geometrical aberration of electrostatic and magnetic quadrupole lenses fed asymmetrically are described. The calculations were made on the basis of the perturbation characteristic functions. The coefficients of the primary (fourth-order) perturbation characteristic function in a general form are given in the appendix. No restrictions were made either for the z-dependence of the field components or the paraxial solution. As a result of the calculations, these formulae can be the starting point of geometrical aberration investigations for different cases. The geometrical aberration coefficients are given in "weak lens" approximation. On the basis of the resulting formulae one can get predictions for the geometrical aberration of the systems mentioned. (auth)

Storage Rings

Refer also to abstract 19489.

19503 (BNL-18860) PARTICLE TRAPPING DURING PASSAGE THROUGH A HIGH-ORDER NONLINEAR RESONANCE. Chao, A. W.; Month, M. (Brookhaven National Lab., Upton, N. Y. (USA)). 22 Apr 1974. 42p. Dep. NTIS $5.25.

A theory of particle trapping and transport during passage through a high order one-dimensional nonlinear resonance is developed. It is a dynamic theory of what is generally referred to as the resonance "lock-in" process. The main result is an expression for the trapping efficiency as a function of the resonance excitation width, the nonlinear detuning, and the speed of passage through the resonance. The trapping efficiency shows a characteristic exponential dependence on crossing speed and

a dependence on phase-space area which follows from rather general arguments connected with the invariance of local particle density. The question of what phase-space region trapped particles are drawn from is discussed. It is shown how the answer to this question is related to the adiabaticity of the system and the phase-space topology. The phenomenon of particle "explosions", occurring at phase-space amplitudes where nonlinear stabilization becomes ineffective, is investigated. The theory has been verified with a computer simulation for crossing a 5th order resonance. The study was undertaken to explain the beam loss in the stacked coasting beams of the ISR storage rings. (auth)

Experimental Facilities

19504 (AED-Conf-74-157-020) HANDLING AND EMISSION CONTROL OF TRITIUM IN THE TRITIUM TARGET MANUFACTURE. Fabian, H. (Nuklear-Chemie und -Metallurgie G. m. b. H (NUKEM), Grossauheim (F. R. Germany)). 1974. 15p. INIS.

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974).

13 figs.; 1 tab.; 5 refs. With abstract.

The processes, methods, and protection measures involved in the manufacture of tritium targets as well as the facilities and equipment used for the processing are presented. Tritium can be handled without substantial emission and without risk of incorporation, if appropriate measures are taken and adequate facilities and equipment are employed. Basing on data from emission measurements and results from personnel control, the proper functioning of the processes employed is demonstrated. (auth)

19505 (IFVE-OP-73-7) PROTON BEAM FOR THE LUDMILA HYDROGEN BUBBLE CHAMBER. Maisheev, V. A.; Samoilov, A. V.; Sapunov, Yu. M.; Sakharov, V. P.; Frolov, A. M.; Gramenitskii, I. M.; Rukovichkin, V. P.; Shafranov, M. D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1973. 25p. (In Russian). INIS.

Calculated and experimental data are given for a beam of primary protons, with ~36 GeV/sec pulses, dispersed on an inner target. The beam was obtained from the IFVE accelerator for irradiation of the 2-meter Lyndmila liquid hydrogen chamber. (tr-auth)

19506 (JINR-10-6883) AUTOMATIC DATA TRANSMISSION BETWEEN THE STORAGE DEVICES OF THE DATA STORAGE AND PROCESSING CENTER. Medved, S. V.; Sinaev, A. N.; Tsakher, G. Yu.; Chistov, N. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 9p. (In Russian). INIS.

An automatic operating regime for a data storage and processing center, used in experiments on the JINR synchrocyclotron, is described. Storage and storage collection are alternated, and the information is transferred to a buffer storage device by programs described earlier and then automatically put onto magnetic tape. Until the beginning of the transmission of the next data, the recorded data are observed. A block diagram of the operation is presented. (tr-auth)

19507 (KHFTI-72-8, pp 115-116) SYSTEM FOR AUTOMATIZATION OF NUCLEAR EXPERIMENT CARRIED OUT BY THE KFTI USING THE COMPUTERS M-220, "DNEPR-21", "DNEPR-22", AND "DNEPR-1". Boriskin, V. N.; Labedev, P. M.; Makarov, A. F.; Yamnitskii, V. A. 1971. (In Russian).

A system is described for the automation of nuclear experiments of the Physics-Technical Institute. Its purpose is to alleviate the burden of physics experimenters, to intensify the experiment, to increase its precision, to process the data during the experiment, and to use the results obtained for optimization of this process. The system was constructed on the basis of two control computers Dnepr-2 and M-220, a series of small Dnepr-1 computers, and auxiliary units, devices, and installations used for connecting the computers with the experimental installations (2-GeV electron accelerator and the heavy particle accelerator). (tr-auth)

19508 (KHFTI-72-8, pp 116-118) SPECTROMETER EXPERIMENT AUTOMATIZATION SYSTEM. Makarov, A. F.; Manevich, V. Z.; Yamnitskii, V. A. 1971. (In Russian).

A system for the automation of spectrometric experiments made on the 2-GeV electron linear accelerator is described. In the system there are the following basic elements: Dnepr-21 digital complex, Dnepr-22 control couples, input bay of experimental data into the Dnepr-22 computer, individual installations for connecting the experimenter with the machines such as teletypes, and oscillographs with light pencils. The dialog program of the experimenter with the machine in the form of input-output communications with teletypes is a major part of the mathematical reliability of the system. The operation of the system on-line with a computer is described. (tr-auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 18688–18690, 18753, 19676, 19695, 19728, and 19770.

19509 (AD-743925) BALLOON EXPOSURE OF 30 m^2 OF CORPUSCULAR PHOTOGRAPHIC MATERIALS IN SEARCH OF SUPER-HEAVY COSMIC RADIATION. Filz, R. C.; Enge, W.; Davis, A. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 6 Apr 1972. 16p. (AFCRL-PSRP-487; AFCRL-72-229). NTIS $3.00.

Thirty square meters of plastic and nuclear emulsions along with some Cherenkov sensitive material were exposed to cosmic radiation at 120,000 feet in May 1971. The balloon was launched from Holloman AFB, New Mexico, (vertical cutoff rigidity pc = 5.0 BV) and remained in the immediate vicinity for 48 hours. During this period, four distinct altitude intervals were distinguished by a sliding plate. Preliminary examination of 1/3 of the cellulose nitrate layer indicates about 170 nuclei of charge greater than iron will be available for study. Precision measurements will be performed on layers of Daicel cellulose nitrate, Bayer cellulose triacetate, and Lexan to determine the charge spectrum of relativistic very heavy cosmic rays. Measurements on the Cherenkov film sensitive to relativistic nuclei with charge greater than 60 and velocity greater than about 0.7 will provide a good check on the velocity and charge of super-heavy nuclei. Preliminary scanning data is discussed. (auth)

19510 (CONF-730804–P2) 13th INTERNATIONAL COSMIC RAY CONFERENCE, DENVER, COLORADO, 17–30 AUGUST 1973. Volume 2. MG and SP Sessions. (Denver Univ., Colo. (USA)). 1973. 1150p. Dep. NTIS $63.50.

Separate abstracts were prepared for each of the 173 papers included. (JWR)

For abstracts of individual papers see: 18688–18690, 18753, 19511–19619, 19672–19730, and 19770.

19511 (CONF-730804-P2, pp 653-657) TRANSPORT PROPERTIES OF COSMIC-RAY PARTICLES IN TURBULENT MAGNETIC FIELDS. Lerche, I. (Univ. of Chicago). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Equations which describe in a statistically exact manner the transport of charged particles in random magnetic fields of arbitrary strength were investigated using the method of Kraichnan (1961). These equations were solved in two situations where the correlation tensor of the turbulent magnetic field takes on particularly simple forms. The same transport problem was solved under the same forms of the magnetic field correlation tensor by an approximate method first used by Jokipii (1965). Comparison of the statistically exact results and the approximate results indicates two points: (1) In one of the situations precise, and exact, agreement between the exact and approximate results obtains. This indicates that the approximate method is much more accurate than hithertofore believed, at least in this case. (2) In the second situation the approximate results and the exact results differ numerically by a factor $2^{\frac{1}{2}}$. The functional form of both results is identical. This again indicates that the approximate method is considerably more accurate than previously thought. These results suggest that Jokipii's approximate treatment of particle transport in turbulent magnetic fields may be of more general validity than its derivation would suggest. If this is true for more general solutions of the Kraichnan equations than we have been able to devise it would indicate that Jokipii's approximate method will generally give the physically correct transport properties. This would be of tremendous help in improving the knowledge of cosmic ray transport, for it would imply that linear approximate equations give the correct physics as opposed to having to work with the non-linear, but exact, Kraichnan equations. (auth)

19512 (CONF-730804-P2, pp 659-662) PARALLEL DIFFUSION COEFFICIENT FOR COSMIC RAYS IN A TURBULENT MAGNETIC FIELD. Klimas, A.; Sandri, G. (Aeronautical Research Associates of Princeton, Inc., Princeton, NJ). 1973.

From 13 international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The parallel diffusion coefficient for cosmic rays in a turbulent magnetic field is recomputed including the new nonresonant interaction. The resulting coefficient is considerably reduced in magnitude and depends very weakly on rigidity for a variety of power-law power spectra. (auth)

19513 (CONF-730804-P2, pp 663-668) PARTICLE DISTRIBUTION FUNCTIONS IN MODULATION THEORY. Forman, M. A. (State Univ. of New York, Stony Brook); Fisk, L. A.; Axford, W. I. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The usefulness of writing the heliocentric modulation equations in terms of the omnidirectional distribution function in phase space, f_0, is discussed. For example, the Compton–Getting factor becomes simply $C = -p(\partial f_0/\partial p)/3f_0$, and the well-known force-field equation reduces to a one-dimensional Vlasov equation in which the force is pVv/3K. Here p is particle momentum, V is solar wind speed, v is the particle speed and K the diffusion coefficient. Another Vlasov equation can be written for the very low energy galactic particles which are convected by the solar wind. In this case the force is $-2vp/3r$, which describes the adiabatic cooling of the particles. Contours of constant f_0 in the (r,p) plane are useful for illustrating both these approximations and the regime between them where C = 0. (auth)

19514 (CONF-730804-P2, pp 669-674) NEW APPROACH TO COSMIC-RAY DIFFUSION THEORY. Jones, F. C. (Goddard Space Flight Center, Greenbelt, MD); Kaiser, T. B.; Birmingham, T. J. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

A new approach to deriving a diffusion equation for charged particles in a static, random magnetic field is investigated. The approach differs from the usual, quasi-linear one, in that particle orbits in the average field are replaced by particle orbits in a partially averaged field. In this way the fluctuating component of the field significantly modifies the particle orbits in those cases where the orbits in the average field are unrealistic. This method allows one to calculate a finite value for the pitch angle diffusion coefficient for particles with a pitch angle of 90° rather than the divergent or ambiguous results obtained by quasi-linear theories. Results of this new approach are compared with results of computer simulations using Monte Carlo techniques. (auth)

19515 (CONF-730804-P2, pp 675-679) COSMIC-RAY DIFFUSION TENSOR AND ITS RADIAL GRADIENT NEAR 1 AU. Sari, J. W. (Calspan Corp., Buffalo). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The magnitude and local radial gradient of the parallel diffusion coefficient for low energy (~ 70 MeV) protons is found to be limited by observations of time profiles of solar flare events and the low energy galactic proton spectrum. The implied coefficient near 1 AU has magnitude $K_{\parallel}(70\ MeV) \sim 2 \times 10^{21}\ cm^2/sec$ and a negative radial gradient (< −100% per AU). This is in accord with calculations of the diffusion coefficient from 1.0 to 0.8 AU utilizing power spectra obtained from Pioneer 6 interplanetary magnetic field data. (auth)

19516 (CONF-730804-P2, pp 680-685) ORIGIN-OF-SCATTER MODEL FOR COSMIC-RAY DIFFUSION AND THE ANISOTROPY PREDICTED AT EARTH. Barnden, L. R. (National Research Council of Canada, Ottawa). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The origin-of-scatter model adopts a microscopic view of the diffusion process in which cosmic rays are considered to follow idealized spiral trajectories between discrete scattering events. The flux of cosmic rays at Earth is expressed as the sum of the fluxes last-scattered from volume elements of interplanetary space along the idealized trajectory for each arrival direction. These trajectories are calculated numerically in a spiral magnetic field. Using the relation between the diffusion coefficient $\kappa(r,P)$ and the number density $U(r,P)$ from the convection-diffusion theory, and after adding the effects of convection, the anisotropy at Earth is obtained. This procedure takes full account of the radial dependence of κ and U and yields a complete 3-dimensional description of the anisotropy at Earth. This has not been possible with any other theory. The predicted diurnal variation is in agreement with theory and observation, and a second har-

monic with the amplitude, phase and spectrum of the observations is present. A third harmonic is also predicted. (auth)

19517 (CONF-730804-P2, pp 686-691) DIURNAL AND SEMIDIURNAL VARIATIONS FROM THE ORIGIN-OF-SCATTER MODEL FOR DIFFERENT VALUES OF κ AND ITS r-DEPENDENCE. Barnden, L. R. (National Research Council of Canada, Ottawa). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The origin-of-scatter model is used to demonstrate how the spectra of the diurnal and semidiurnal variations change as we change the values of κ and its r-dependence. A simple mechanism for the semidiurnal variation is given. A method to determine the r-dependence of κ is suggested. (auth)

19518 (CONF-730804-P2, pp 694-699) COSMIC RAY MODULATION AT NEUTRON MONITOR ENERGIES USING THE FORCE-FIELD SOLUTION. Moraal, H.; Stoker, P. H.; Henning, J. J. (Potchefstroom Univ. for C.H.E., South Africa). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

A method is developed to describe the modulation of cosmic rays, to which neutron monitors are sensitive, in terms of the force-field solution of the streaming equation of interplanetary cosmic rays. In this description atmospheric differential responses from latitude surveys at 226 mm Hg are related at different times during the solar cycle. It is shown that the rigidity dependence of the cosmic ray diffusion coefficient changed as the solar cycle progressed. With the aid of differential response functions near sea level, as well as the data of stationary neutron monitors, it is also shown that the steplike nature of the modulation can be explained in terms of steplike changes in the rigidity dependence of the diffusion coefficient. (auth)

19519 (CONF-730804-P2, pp 700-705) SOLAR WIND DECELERATION EFFECTS IN COSMIC-RAY VARIATIONS. Salimzibarov, R. B.; Klimenko, V. V.; Shafer, Yu. G. (Inst. of Cosmophysical Research and Aeronomy, Yakutsk, USSR). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The effects in cosmic ray variations are described which interpretation is impeded in frame of the solar wind freely escaping great heliocentric distances away. (auth)

19520 (CONF-730804-P2, pp 706-712) CHARGED PARTICLE INTENSITY FLUCTUATIONS IN INTERPLANETARY MAGNETIC FIELD. Dorman, L. I.; Kats, M. E. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Charged particle intensity fluctuations in interplanetary magnetic field with regular and random components are examined. (auth)

19521 (CONF-730804-P2, pp 713-720) GALACTIC COSMIC-RAY DENSITY DISTRIBUTION IN INTERPLANETARY SPACE EXPECTED ON THE BASIS OF ANISOTROPIC DIFFUSION THEORY INCLUDING THE ACTUAL DISTRIBUTION OF SOLAR ACTIVITY OVER SOLAR DISC. Dorman, L. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow); Milovideva, N. P. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The expected cosmic ray density distribution for various solar cycle periods is found by numerically solving the stationary equation of the galactic cosmic ray anisotropic diffusion in interplanetary space using a computer and including radial convection and adiabatic cooling of particles. The diffusion tensor heliolatitude distribution is selected for each period on the basis of the data of sunspot number. The results obtained are compared to the experimental data on the 11-year and yearly variations, and the radial and transverse cosmic ray components for various periods of solar activity cycle. (auth)

19522 (CONF-730804-P2, pp 721-731) MODULATION OF THE SPECTRUM, THE RADIAL AND TRANSVERSE GRADIENTS OF GALACTIC COSMIC RAYS IN A COMBINED MODEL OF ANISOTROPIC AND ISOTROPIC DIFFUSION INCLUDING CONVECTION AND ADIABATIC COOLING OF PARTICLES IN INTERPLANETARY SPACE. Dorman, L. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow); Kobylinskii, Z. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The results of computer calculations of anisotropic (in the near regions of interplanetary space) and isotropic (in the remote regions) diffusion including convection, adiabatic cooling, and boundary conditions on the basis of the methods of nets are presented. The galactic cosmic ray energy spectrum modulation at various distances from the Sun has been determined and the radial and transverse gradients of cosmic ray density have been calculated for various heliolatitude and heliolongitude distributions of solar wind. (auth)

19523 (CONF-730804-P2, pp 732-737) SOLAR MODULATION OF COSMIC-RAY PROTONS AND He NUCLEI. Garrard, T. L.; Stone, E. C.; Vogt, R. E. (California Inst. of Tech., Pasadena). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The results of a detailed, quantitative study of the solar modulation of cosmic-ray protons and He nuclei are presented. The study is based on: (a) observations over the 1966 to 1970 period with balloon- and satellite-borne instruments, (b) numerical solutions of the cosmic-ray transport equation, and (c) propagation parameters derived from studies of near-Earth and interstellar spectra of cosmic-ray electrons. It was found that consistent, quantitatively satisfactory results may be obtained with a model of solar modulation which uses a diffusion coefficient separable into functions of heliocentric radius and particle rigidity and in which adiabatic deceleration has a dominant role in shaping the low-energy spectra of nuclei near 1 AU. (auth)

19524 (CONF-730804-P2, pp 738-742) CALCULATION OF A REALISTIC GRADIENT AS A FUNCTION OF RADIAL DISTANCE FROM THE SUN. Lezniak, J. A.; Webber, W. R. (Univ. of New Hampshire, Durham). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Numerical calculations of radial gradients of galactic cosmic ray protons have been performed for a model of the interplanetary cavity which includes processes of diffusion along the spiral interplanetary magnetic field lines, convection, and adiabatic energy change. The increasing spiral nature of the field lines with increasing distance from the sun results in the bulk of the modulation region being beyond the earth. The radial gradients for this model are found to be small near the earth and out to a few AU, increasing as one approaches the boundary. (auth)

19525 (CONF-730804-P2, pp 743-748) HELIOSPHERIC INTENSITY GRADIENTS OF GALACTIC COSMIC-RAY NUCLEI AND ELECTRONS FROM PIONEER 10. Lentz, G. A.; McKibben, R. B.; O'Gallagher, J. J.; Perkins, M.; Simpson, J. A.; Tuzzolino, A. J. (Univ. of Chicago). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Preliminary results on the radial gradient of galactic cosmic rays as measured by the University of Chicago main telescope on board the Jupiter probe Pioneer 10 are reported. The measurements were made over a radial range 1 to 3.2 au. For relativistic cosmic rays an integral gradient ($\lesssim$70 MeV nucleon^{-1}) of (3 ± 1) % per au was found. For protons and helium nuclei in the range 29 to 67 MeV nucleon^{-1}, differential gradients of (3 ± 7) % per au and (-5 ± 7) % per au, respectively, were found. For 7 – 30 MeV electrons, a conservative upper limit on the differential gradient of 50% per au was found. (auth)

19526 (CONF-730804-P2, pp 750.1-750.6) HELIOCENTRIC RADIAL DEPENDENCE OF GALACTIC COSMIC-RAY INTENSITY TO AND BEYOND 3.3 AU. Van Allen, J. A. (Univ. of Iowa, Iowa City). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Comparing the counting rates of omnidirectionally shielded Geiger-Mueller tubes on the Jupiter-bound spacecraft Pioneer 10 with those of a similar tube on Explorer 35 at 1 au, it is found that the heliocentric radial gradient G of galactic cosmic ray intensity is zero to an uncertainty of $\pm 1\%$/au for $E_p > 80$ MeV and radial distance r in the range $1.0 < r < 4.1$ au. This value is at least an order of magnitude smaller than prevailing theoretical estimates which are derived from interplanetary magnetic-field power-spectra near the plane of the ecliptic (and near 1 au) and

the assumption of spherical symmetry. It is suggested that the diffusion coefficient is markedly greater at moderate to high solar latitudes than it is near the solar equator and that the effective diffusion coefficient of galactic cosmic rays throughout the solar system has more nearly its out-of-ecliptic values. Recent radio-source-scintillation measurements of Houminer [1973] are cited in support of this interpretation as is a related suggestion by Hedgecock et al. [1972]. (auth)

19527 (CONF-730804-P2, pp 753-758) COSMIC-RAY ELECTRON SPECTRUM AND ITS MODULATION FROM 1968 THROUGH 1972. Fulks, G. (Univ. of Chicago); Meyer, P.; L'Heureux, J. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Over the past five years the energy spectrum of primary cosmic ray electrons has been measured with both a balloon-borne and a satellite absorption spectrometer. All of the balloon flights used identical equipment that was launched each summer from Fort Churchill, Manitoba, Canada. The satellite, OGO-5, has been in an eccentric orbit since March 1968. Together these instruments provide the electron spectrum over a range of energy from 20 MeV to 20 GeV. This wide range and the substantial span of time covered by the measurements permit a detailed study of the solar modulation of electrons. These results are compared with the modulation of the nuclear components as observed by a neutron monitor and interpreted using the cosmic ray transport equation. (auth)

19528 (CONF-730804-P2, pp 760-764) MEASUREMENTS OF THE PRIMARY COSMIC-RAY ELECTRON SPECTRUM FROM 1965 TO 1972. Webber, W. R.; Kish, J.; Rockstroh, J. M. (Univ. of New Hampshire, Durham). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Data on the primary electron spectrum from ~5 MeV to ~30 GeV are presented for a large number of balloon flights in the years 1965 to 1972. A new much larger area electron telescope was introduced to these studies in 1971 and the results from this new telescope are given and compared with earlier results. Detailed electron spectra are presented and the effects of solar modulation are examined over a wide energy range. The phase lag or hysteresis in the electron intensity observed after 1969 is also examined between 40 MeV and 1 GeV. (auth)

19529 (CONF-730804-P2, pp 765-770) ANALYTIC APPROXIMATIONS IN THE STUDY OF THE SOLAR MODULATION OF ELECTRONS. Cummings, A. C.; Stone, E. C.; Vogt, R. E. (California Inst. of Tech., Pasadena). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Numerical solutions to the transport equation of galactic cosmic rays in the interplanetary medium have been used to investigate the applicability of commonly used approximate analytic solutions for electrons (10 MeV to 10 GeV). It is found that for a given cosmic-ray diffusion coefficient: (a) the "force-field" approximation is in reasonable agreement with the numerical solution at energies $\gtrsim$200 MeV, but deviates significantly at lower energies, depending on the shape of the interstellar electron spectrum, (b) the "diffusion-convection" approximation agrees generally with the numerical solution within a factor of ~2 over the entire energy range. (auth)

19530 (CONF-730804-P2, pp 772-776) INTERPLANETARY DIFFUSION COEFFICIENTS FOR COSMIC RAYS. Cummings, A. C.; Stone, E. C.; Vogt, R. E. (California Inst. of Tech., Pasadena). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Information on the cosmic-ray diffusion coefficient, κ, derived from near-Earth observations of the solar modulation of galactic electron fluxes and from the near-Earth power spectra of the interplanetary magnetic field, has been used to study the heliocentric radial dependence of κ and to derive limits on the spatial extent of the solar modulation region. Representing κ as a separable function of radius r and rigidity, and assuming $\kappa(r) \propto r^n$, a limit can be placed on the power law exponent, $n \gtrsim 1.2$. The distance of the modulation boundary is a function of n, and, e.g., for n = 0, falls into the range of 6-25 au. (auth)

19531 (CONF-730804-P2, pp 777-782) RELATION BETWEEN COSMIC-RAY FLUCTUATIONS, GRADIENT, AND DIFFUSION COEFFICIENT. Owens, A. J.; Jokipii, J. R. (California Inst. of Tech., Pasadena). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The motion of charged particles in a stochastic magnetic field is considered via a generalized quasi-linear expansion of Liouville's equation. The result is an equation relating cosmic-ray scintillations to particle gradients and to magnetic-field fluctuations (or diffusion coefficient). The resulting theory may be regarded as an example of a fluctuation-dissipation phenomenon, in which the diffusion coefficient plays the role of the dissipative parameter. The resonant interaction between particles and the random interplanetary magnetic field is considered explicitly, and it is shown that observed scintillations of high-energy (~1 GeV) cosmic rays may be reasonably explained by the model. (auth)

19532 (CONF-730804-P2, pp 783-788) POWER SPECTRUM OF THE COSMIC-RAY INTENSITY VARIATION. Fujii, Z. (Nagoya Univ., Japan); Mori, S.; Yasue, S.; Nagashima, K. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Power spectra of the cosmic ray intensity variations covering the frequency range of 0.01 to 100 cph (cycles per hour) were studied based on the data observed by Mt. Norikura multi-directional cosmic ray telescope (36 m^2 area) in 1971. Any significant peak at particular frequency was not found besides that of the daily variation harmonics up to the third. The frequency dependence of the derived spectrum was shown to have a shape of $f^{-1.7}$ up to ~1 cph. Above this frequency, the slope of the spectrum tends to become flat towards the higher frequency end. This flattening, however, is interpreted as due to the white noise power of the fluctuations of cosmic rays obeying the Poisson distribution. After subtracting this white noise power, the cosmic ray spectrum has a shape of $f^{-1.7}$ up to several cph. (auth)

19533 (CONF-730804-P2, pp 789-794) SPECTRAL ANALYSIS OF GALACTIC COSMIC-RAY INTENSITIES AT DIFFERENT ALTITUDES. Lanzerotti, L. J. (Bell Labs., Murray Hill, NJ); Robbins, M. F.; Venkatesan, D. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Power spectra of the counting rates of the Calgary and Sulphur super neutron monitors are investigated in order to study the nature of the cosmic ray scintillations reported by two previous groups. The spectra observed to be very flat at high frequencies ($\gtrsim 10^{-3}$ Hz) steepen appreciably at lower frequencies, with power-law slopes between ~−1.5 and ~−2.0, depending upon the time interval analyzed. The Alert spectrum calculated by Owens and Jokipii (1972) is very similar to the Sulphur Mountain spectrum determined for the common period, September–November, 1969. The variability observed in the spectra of galactic cosmic ray variations computed for different time periods leads to the expectation that these spectra can be used to investigate the interplanetary modulation region. (auth)

19534 (CONF-730804-P2, pp 795-799) SPECTRAL ANALYSIS OF COSMIC-RAY VARIATIONS IN THE 10^{-1} TO 10^{-3} HZ FREQUENCY BAND. Attolini, M. R.; Galli, M.; Guidi, I. (CNR, Bologna). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Accurate calculations of power spectral density of cosmic ray data from some ground stations, in the cut-off rigidity interval (0.1 – 15) GV, have been calculated. Correction for Poissonian fluctuation and aliasing effects is also made. The spectra separately follow a definite power law with exponents ranging from −1.65 to −1.95, if the peaks of solar and terrestrial rotation are ignored. The 24h anisotropy appears to be made of a transient part lasting from 4 to 6 days, and of a persistent part which has a constant amplitude of about 0.3% at middle latitudes. (auth)

19535 (CONF-730804-P2, pp 800-802) PHASE SHIFT BETWEEN COSMIC-RAY VARIATION OF TWO CLOSE BY STATIONS. Attolini, M. R.; Galli, M.; Guidi, I. (CNR, Bologna). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The cross spectral analysis of hourly pressure corrected neutron data for the years 1966–1967–1968, from Kiel and Leeds stations has been made. The common variations between 10^{-5} to 10^{-3} Hz appear to be shifted of about half an hour from one station to the other. The phase shift of the persistent part of the diurnal wave attributable to the effect is considerably greater than the

one theoretically predicted; its amplitude seems somewhat smaller. (auth)

19536 (CONF-730804-P2, pp 803-807) BALLOON OBSERVATION OF SHORT-PERIOD VARIATIONS OF COSMIC-RAY INTENSITY. Kodama, M. (Inst. of Physical and Chemical Research, Tokyo); Sakai, T.; Tamai, E. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

To search for short period variations of cosmic ray intensity, a tentative measurement at a balloon altitude near the Pfotzer maximum has been carried out in low latitude. Two sets of plastic scintillation detectors gave about 3500 counts per second. Analyses of the power spectrum density as a function of time suggest a possible existence of quasi periodic variations with period of the order of minute. However, the so-called white noise due to the insufficient counting rate gives no definite conclusion about which origin is predominant, interplanetary, atmospheric, or others. (auth)

19537 (CONF-730804-P2, pp 820-824) MULTIPLE NEUTRON CHARACTER OF THE LONGTERM VARIATION IN COSMIC-RAY INTENSITY DURING THE IASY. Kodama, M. (Inst. of Physical and Chemical Research, Tokyo). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Using the data from multiplicity measurements on the NM64 neutron monitor at Syowa Station, Antarctica, the longterm variation covering two years of the IASY has been investigated in terms of spectral modulation. From analyses of the multiplicity spectrum and the mean multiplicity, it is shown that the slope of the primary cosmic ray spectrum becomes harder transiently twice on the way of the descending phase of solar activity cycle. The quantitative effect of atmospheric temperature on the longterm variation is discussed. (auth)

19538 (CONF-730804-P2, pp 825-830) STUDIES OF MODULATION AND SOLAR PARTICLE EVENTS USING NEUTRON MONITOR MULTIPLICITIES. Kent, D. W. (Bartol Research Foundation, Swarthmore, PA). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

A comparison of the response of multiple events in a neutron monitor with that of the total counting rate can be used as a means of studying spatial variations of the energy spectrum of modulation in Forbush decreases as well as in solar particle events. Events with multiplicity 4 or greater are compared with the total counting rates at the Bartol network of stations during seven Forbush decreases and three solar particle events that occurred in the period 1970 to 1973. Spectral indices are then estimated on the basis of a modified form of calculated yield functions. (auth)

19539 (CONF-730804-P2, pp 831-834) REEXAMINATION OF THE PRESSURE CORRECTED NEUTRON MONITOR DATA. Ogita, N. (Inst. of Physical and Chemical Research, Saitama, Japan); Yoshida, S.; Niikura, T.; Wada, M. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The spherical harmonic analysis performed so far covers all the 27 days periods for years 1966 to 1968. This analysis makes possible to examine the pressure corrected neutron monitor data reported from each station. Correlations between daily mean pressures and residues of the observed data from primary variations reconstructed from the harmonic coefficients were studied. The result shows that the pressure coefficients at stations with the cutoff rigidities less than 2 GV are expressed as a function of mean atmospheric pressure at the stations only, within the present accuracy. (auth)

19540 (CONF-730804-P2, pp 835-842) CALCULATIONS OF THE INTEGRAL GENERATION MULTIPLICITY, COUPLING COEFFICIENTS, AND PARTIAL BAROMETRIC COEFFICIENTS FOR THE COSMIC-RAY NEUTRON COMPONENT OBSERVATIONS AT VARIOUS ALTITUDES USING THE METHOD OF DISCONTINUOUS MARKOV PROCESSES INCLUDING NONORDINARITY OF NUCLEAR-MESON CASCADE. Dorman, L. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow); Rishe, G. E. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Great difficulties encountered when determining the generation integral multiplicity, coupling coefficients, and partial barometric coefficients for the neutron component by directly solving the equations of the nuclear-meson cascade in the Earth's atmosphere stimulated searches for another method making it possible to neglect the intermediate details of cascade development and to rapidly find the final result. This can be realized by using the formalism of discontinuous Markov processes including nonordinarity of random events in the nuclear-meson cascade. In this case the numerical integral characteristics of the process are determined from the comparison with the data on the altitude dependence, latitudinal distribution, energy spectrum, and other integral effects of the neutral component. A portion of the results obtained which can be compared with available experimental data shows a good agreement with the experiment. (auth)

19541 (CONF-730804-P2, pp 843-850) STUDIES OF THE COUPLING COEFFICIENTS OF THE COSMIC-RAY NEUTRON COMPONENT FOR THE PERIOD OF 1967–1971. Avdeev, E. A.; Bednazhevskii, V. M.; Blokh, Ya. A.; Viskov, V. V.; Dorman, L. I.; Manshilina, A. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The latitude effect of the cosmic ray neutron component for the period of 1967-1971 has been measured at sea level. The coupling coefficients, integral generation multiplicities, and spectrum of the 11-year variation have been calculated. (auth)

19542 (CONF-730804-P2, pp 851-856) IMPLICATIONS OF SCALING FOR THE MEDIAN PRIMARY ENERGY IN ANISOTROPY EXPERIMENTS. Groom, D. E.; Morrison, J. L. (Univ. of Utah, Salt Lake City). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The energy spectrum of primary cosmic ray protons responsible for muons observed at fixed depth underground has been calculated under the hypothesis of scaling of hadronic interactions. For a threshold muon energy $E_{\mu 0}$ (near 100 GeV), the median primary energy is 10.4 $E_{\mu 0}$. It is concluded that only a small fraction of the muons observed in any of the high precision anisotropy experiments arose from protons with sufficient rigidity to penetrate the solar field without extreme deflection. (auth)

19543 (CONF-730804-P2, pp 863-868) CALCULATIONS OF THE COUPLING COEFFICIENTS FOR COSMIC-RAY MUON AND NEUTRON COMPONENTS. Boos, E. G.; Efimov, A. K.; Kolomeets, E. V.; Kupchishin, A. I. (Kazakh State Univ., Alma-Ata, USSR). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The results of the calculation of coupling coefficients (functions) for cosmic ray muons at sea level, at mountain altitudes 843,680,312 g/cm^2 and at depths 20,60,100 mwe below sea level are presented as well as for cosmic ray neutrons at atmospheric depths 680,843 and 1033 g/cm^2 at solar maximum and minimum. (auth)

19544 (CONF-730804-P2, pp 870-875) SIDEREAL AND ANTISIDEREAL DIURNAL VARIATIONS AT NEUTRON AND MUON MONITOR ENERGIES. Gold, R. E. (Univ. of New Hampshire, Durham); Peacock, D. S. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Statistically significant sidereal and antisidereal diurnal variations with an amplitude of several hundredths of a percent are seen by neutron monitors and muon monitors, both on the surface and underground. These variations are neither atmospheric nor galactic in origin. Both the sidereal and antisidereal data are organized by the polarity of the interplanetary magnetic field. The Swinson model of the sidereal variation is not sufficient to account for the observations since it predicts neither the phase of the sidereal wave for surface monitors nor the existence of an antisidereal wave. Extension of the Swinson model to include the effects of (1) seasonal geometry changes, (2) density gradients perpendicular to the ecliptic, and (3) seasonal preferences in the interplanetary magnetic field polarity, improves the agreement with the observed sidereal variation. (auth)

19545 (CONF-730804-P2, pp 890-895) PRIMARY AND ALBEDO COSMIC RAYS INTENSITY IN THE EARTH'S VICINITY. Charakhchyan, T. N.; Bazilevskaya, G. A.; Stozhkov, Yu. I. (Lebedev Inst. of Physics, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The results of regular stratospheric measurements are used to obtain the half-yearly averages of primary cosmic rays at magnetic rigidity P > 0.5 GV, T(p > 0.5) for 1965-1972. The relation between T(p > 0.5) and cosmic ray flux in the stratospheric transition peak, N_m, (Murmansk and Mirny) has been found to be linear. The data about T_s fluxes and spectra of the albedo cosmic ray particles at the atmospheric boundary have been obtained for some geomagnetic latitudes. The value of T_s with a path smaller than 2 g/cm^2 is about a half of the total albedo particle flux with a path greater than 0.1 g/cm^2. The albedo photon fluxes are 20 times in excess of the charged albedo particle fluxes. (auth)

19546 (CONF-730804-P2, pp 987-902) FLUXES AND CHARGE COMPOSITION OF LOW-ENERGETIC HEAVY NUCLEI IN THE ATMOSPHERIC DEPTH OF 40 TO 100 g cm^{-2}. Allkofer, O. C.; Dispert, H.; Heinrich, W. (Univ., Kiel). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Two plastic stacks containing cellulosenitrate as detector material were flown several times with balloons at 40 g cm^{-2} for a total time of 25 hours. The stacks measured 40 × 40 cm^2 and had a total depth of 33 g cm^{-2}. About 75 m^2 of the exposed cellulosenitrate foils were etched and scanned for tracks of heavy nuclei. The measurement of 920 tracks made it possible to determine the intensities of four charge groups ($6 \le Z \le 9$, $10 \le 7 \le 14$, $15 \le Z \le 19$, $20 \le Z \le 28$); the vertical intensities have been derived from the angular fluxes for atmospheric depths from 40 to 100 g cm^{-2}. The charge spectra of nuclei having penetrated 40 – 50 g cm^{-2}, 50 – 65 g cm^{-2} and 65 – 120 g cm^{-2} of air respectively show the influence of fragmentation of the primary nuclei in the atmosphere. (auth)

19547 (CONF-730804-P2, pp 903-908) MEASUREMENT OF EARTH ALBEDO NEUTRONS FROM 70 TO 300 MeV. Reppin, C.; Kanbach, G.; Schoenfelder, V. (Max-Planck-Institut fuer Extraterrestrische Physik, Garching, Ger.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Measurements of earth albedo neutrons in the energy range from 70 to 300 MeV were performed with a directional double scattering neutron detector. The balloon borne experiment was flown two times at 40° geomagnetic latitude on May 1 and 25, 1971 and reached float altitudes of 107,000 ft (8.6 g/cm^2) and 120,000 ft (4.7 g/cm^2). The efficiency of the detector has been determined by extensive calibration measurements at the Synchrocylotron at A.E.R.E. Harwell. The albedo neutron flux and the angular distribution of atmospheric neutrons are presented and compared with calculations and measurements of other authors. (auth)

19548 (CONF-730804-P2, pp 909-914) HIGH-ENERGY NEUTRONS AT BALLOON ALTITUDES. Klumpar, D. M.; Lockwood, J. A. (Univ. of New Hampshire, Durham). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The flux and energy spectrum of fast neutrons (3 < E < 20 MeV) have been measured near the top of the atmosphere with an organic liquid scintillator. The omnidirectional neutron energy spectrum from 3 to 20 MeV at 3.5 g/cm^2 over Palestine, Texas (λ = 42°N) can be described by a power law, $AE^{-\gamma(E)}$, with an energy dependent spectral index where $\gamma = 1.8 \pm 0.2$ (3 < E < 10 MeV), 0.9 ± 0.2 (10 < E < 15 MeV), and 0.3 ± 0.3 (15 < E < 20 MeV). From 20 to 50 MeV, a neutron spectrum independence of E is consistent with the data. The neutron leakage current from 3 to 10 MeV at solar minimum was 0.089 neutrons/cm^2 sec. (auth)

19549 (CONF-730804-P2, pp 916-920) ATMOSPHERIC GAMMA-RAY SPECTRUM FROM 50 MeV to 1 GeV AT 3 MBAR AND SEA LEVEL. Staib, J.; Frye, G.; Zych, A. (Case Western Reserve Univ., Cleveland). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Scattering measurements on the electron and positron tracks from the gamma-ray pairs in a spark chamber have been analyzed to yield the energy spectrum of atmospheric gamma rays between 50 MeV and 1 GeV. Moliere's multiple scattering theory was used and checked with calibration runs at the Cornell 2 GeV synchrotron. The data can be fit by a power law with exponent −1.45, 50-250 MeV; and −2.30, 250-1000 MeV. No difference is seen in the shape of spectrum for the two cutoffs, but the flux decreases by a factor of two between 4.5 and 12 GV. Data will also be presented on the sea level spectrum and angular distribution. (auth)

19550 (CONF-730804-P2, pp 921-926) PRODUCTION OF GAMMA RAYS WITH E ≥ 30 MeV IN THE ATMOSPHERE. Thompson, D. (Univ. of Maryland, College Park). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

A three-dimensional study of atmospheric gamma rays with energy greater than 30 MeV has been carried out. Experimental results were obtained from four balloon flights from Palestine, Texas, with a 15 cm by 15 cm digitized wire grid spark chamber. The energy spectrum for downward-moving gamma rays steepens with increasing atmospheric depth. Near the top of the atmosphere, the spectrum steepens with increasing zenith angle. Experimental results compare reasonably well with a three-dimensional Monte Carlo calculation of atmospheric gamma ray production. Inclusion of upward-moving gamma rays makes possible the use of atmospheric secondaries for in-flight calibration of satellite gamma ray detectors. (auth)

19551 (CONF-730804-P2, pp 927-932) ATMOSPHERIC GAMMA RADIATION AT ENERGIES >10 MeV. Seeman, N.; Share, G. H.; Kinzer, R. L. (Naval Research Lab., Washington, DC). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

A balloon-borne telescope, employing a wide-gap spark chamber and a nuclear emulsion stack, has been used to study the rates of production and energy spectra of atmospheric gamma radiation at vertical cutoff rigidities of 4.5 GV and 11.5 GV. At these cutoffs the production rates of photons with energies between 10 and 200 MeV are, respectively, $(2.5 \pm 0.6) \times 10^{-3}$ and $(1.2 \pm 0.3) \times 10^{-3}$ γ/cm^2-sec-sr-(g/cm^2). The shape of the differential spectrum measured at 4.5 GV is in reasonable agreement with that predicted by Beuermann (1971), verifying the strong contribution of photons from electron bremsstrahlung. However, an enhancement observed above 50 MeV in the spectrum at the 11.5 GV threshold suggests a greater relative contribution from π^0-decay gamma rays at higher geomagnetic cutoffs. (auth)

19552 (CONF-730804-P2, pp 933-938) LATITUDE VARIATION OF 510-keV LINE INTENSITY AND ABSORPTION LENGTH OF ATMOSPHERIC GAMMA RADIATION. Bemalkhedkar, M. M. (Physical Research Lab., Ahmedabad, India); Razdan, H. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The measurement of the atmospheric gamma radiation in a balloon flight on April 30, 1971 at Hyderabad (Geomag. Lat.: 7.6°N) and in earlier flights by various authors reveals the inverse dependence of the 510 keV line intensity and the direct dependence of the absorption length on the fourth power of cosine of the geomagnetic latitude of the flight station. The absorption length of the atmospheric gamma radiation at a particular latitude shows no relation with energy in the range of about 100 keV to 5 MeV. The results are consistent with the latitude variation in the primary cosmic rays producing the atmospheric gamma radiation. (auth)

19553 (CONF-730804-P2, pp 939-942) COSMIC-RAY VARIATIONS WITH PERIODS LESS THAN 12 HOURS. Kozlov, V. I.; Kuzmin, A. I.; Krymskii, G. F.; Filippov, A. G.; Chirkov, N. P. (Inst. of Cosmophysical Research and Aeronomy, Yakutsk, USSR). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Short-term cosmic ray variations using 5-min data of Tixie Bay and Khabarovsk NM-64 for the period August 3–5, 1972 are analyzed. It is obtained that for above period the dynamics of power spectra connected with the solar cosmic ray flare and Forbush-decreases on August 4, 1972 is observed. The evidences of extraterrestrial short-term cosmic ray variations are given. (auth)

19554 (CONF-730804-P2, pp 943-947) ANISOTROPY OF THE THIRD HARMONIC DIURNAL VARIATION OF COSMIC-RAY NEUTRON INTENSITY AND ITS RELATION WITH THE SOLAR ACTIVITY. Kanno, T. (Fukushima Univ., Japan); Ishida, Y.; Saito, T. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Tmn3c (the anisotropy of the third harmonic diurnal variation of cosmic-ray neutron intensity in space) was discussed for the data observed with neutron monitors in Deep River and other stations, and the following results were confirmed. (1) Tmn3c seems to exist in the direction of ~1 hr or ~5 hr in average through the entire period. (2) $\langle Tmn3 \rangle_Y$ (yearly vector mean value of Tmn3) has the excellent correlation with the green line (5303Å) intensity of solar corona in the low heliographic latitude. (3) From the frequency distribution of Tmn3, Tmn3c seems to exist in the direction of ~5 hr during the solar active period, and ~1 hr during the solar calm period. (auth)

19555 (CONF-730804-P2, pp 948-952) WORLDWIDE COSMIC-RAY SOLAR TRIDIURNAL VARIATION. Ahluwalia, H. S.; Singh, S. (Univ. of New Mexico, Albuquerque). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The existence of solar tridiurnal variation in cosmic ray data obtained at Deep River over the ten year period 1962–1971 is confirmed. Cosmic ray data from the global network of neutron and muon detectors are analyzed during the period of the rising phase of solar activity cycle-20, namely 1966–1970. It is found that a statistically significant (amplitude $>2\sigma$) solar third harmonic exists in the data obtained at the low and middle latitude stations, indicating its worldwide nature. The amplitude of the third harmonic varies considerably from one year to the next, however. These fluctuations appear to bear no obvious correlation with the level of the solar activity. No statistically significant solar tridiurnal variation exists in the data obtained at the polar stations, during the period of the analysis. (auth)

19556 (CONF-730804-P2, pp 954-959) THREE-DIMENSIONAL COSMIC-RAY ANISOTROPY IN INTERPLANETARY SPACE BASED ON AN ANALYSIS OF ANNUAL MODULATION OF COSMIC-RAY SOLAR DIURNAL VARIATION. Mori, S. (Shinshu Univ., Matsumoto, Japan). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

One of the characteristic features of three-dimensional cosmic-ray anisotropy in space has been studied, based on an analysis of annual modulation of cosmic-ray solar diurnal variation. By utilizing difference vectors between selected pairs of conjugate neutron monitor stations on both northern and southern hemispheres, systematic annual movements of solar diurnal variations are clearly observed for the period of 1964–1968. These annual variations of solar diurnal variations can be reasonably interpreted in a framework of Nagashima's theory, as resulting from annual modulation of a "special" diurnal term $D^1_1(t)$ due to earth's revolution around the sun. The term of $D^1_2(t)$ is one of terms expected from three-dimensional cosmic-ray anisotropy in space which is also associated with solar semi-diurnal anisotropy, and its characters are discussed. (auth)

19557 (CONF-730804-P2, pp 960-962) VARIATION OF DIURNAL VARIATION OF COSMIC-RAY NEUTRON INTENSITY DURING THE PERIOD OF IGY–IQSY. Kanno, T.(Fukushima Univ., Japan); Ishida, Y.; Saito, T. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The worldwide distribution of Tmn (the local time of maximum in the diurnal variation of cosmic ray neutron intensity) and their variation were investigated with the data during the period from IGY to IQSY, and then it was confirmed that the contours of Tmn's during the period of IQSY appeared to return eastward from those that had been shifted westward during the period of IGY, as predicted previously from the data of IGY. (auth)

19558 (CONF-730804-P2, pp 963-968) ATTENUATION OF A GALACTIC ANISOTROPY BY 2 AND 4 SECTOR INTERPLANETARY MAGNETIC FIELDS. Barnden, L. R. (National Research Council of Canada, Ontario); McCracken, K. G. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Cosmic ray trajectories have been calculated numerically in both 2 and 4 sector spiral interplanetary magnetic field models. The "helio-asymptotic" directions at 10 AU thus obtained were used to derive the relative amplitude of the sidereal diurnal variation at Earth when an anisotropy is imposed in interstellar space. It is found that the effective lower cut-off energy for the observation at Earth of such a galactic anisotropy is considerably higher for the 2-sector field. These results are used to calculate the sidereal variation amplitude expected at a detector 60 m.w.e. underground. (auth)

19559 (CONF-730804-P2, pp 970-975) SIDEREAL ANISOTROPY OBSERVED UNDERGROUND. Swinson, D. B. (Univ. of New Mexico, Albuquerque). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Three years of data (1968–1970) from underground mu-meson telescopes at Bolivia (25 m.w.e.), Embudo (40 m.w.e.) and Socorro (80 m.w.e.), with threshold rigidities 17 GV, 30 GV, and 52GV, respectively, have been analyzed in sidereal time as a function of interplanetary magnetic field direction. When the field points away from the sun the observed sidereal anisotropy for each telescope is near the 0600 S.T. direction, while when it points towards the sun the observed sidereal anisotropy is near the 1800 S.T. direction. These anisotropies are considerably larger than the residual anisotropy obtained when all data are analyzed regardless of field direction. It is difficult to reconcile these observations with the presence of a real sidereal anisotropy at these sidereal times, as has been suggested previously on the basis of data from telescopes at depths less than 80 m.w.e. (auth)

19560 (CONF-730804-P2, pp 976-981) UNDERGROUND COSMIC-RAY OBSERVATIONS AND INTERPLANETARY MAGNETIC FIELD DIRECTIONS. Humble, J. E. (Univ. of Tasmania, Hobart, Australia); Fenton, A. G.; Speller, R. D.; Otaola, J. A.; Thambyahpillai, T.; Dutt, J. C.; Mathews, T.; Miyazaki, T.; Peacock, D. S. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The diurnal variations in sidereal time in the data from the Hobart and London underground detectors have been investigated as functions of the interplanetary magnetic field direction. The directions used have been obtained both from direct space-craft observations and by inference from Svalgaard's listings of polar magnetometer characteristics. The Hobart observations show a field-direction dependent effect different from that predicted by the Swinson model. A possible explanation involves the combination of a Swinson-type effect and a field independent component in the 0600 Sidereal time direction. The London observations do not show an obvious Swinson effect. (auth)

19561 (CONF-730804-P2, pp 982-985) DIURNAL ANISOTROPIES OF THE COSMIC-RAY INTENSITY UNDERGROUND. Antonucci, E.; Castagnoli, G. C.; Dodero, M. A.; Giraud, C. (CNR, Turin). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The analysis of the diurnal variations of underground c.r. intensities on a day-to-day basis is performed. At the depths of the London and of the Torino stations an anisotropy in the direction of the interplanetary magnetic field is observed in addition to the corotation effect, which varies in relation to the perturbations produced by the Sun. This effect is not recorded in the Hobart data during the same time of observation. (auth)

19562 (CONF-730804-P2, pp 986-991) ANISOTROPY DUE TO COSMIC-RAY DENSITY GRADIENTS DURING SOLAR MAXIMUM. Kargathra, L. V.; Subramanian, G. (Physical Research Lab., Ahmedabad, India). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Using the interplanetary magnetic field sector polarity data and the Ahmedabad meson and world-wide neutron intensity observations, a study has been made of the diurnal anisotropy related to the interplanetary magnetic field (ipmf) direction. The direction of this anisotropy observed during 1968 is consistent with the anisotropy being produced by the ipmf and the north–south cosmic ray density gradient. The direction of this anisotropy reverses during 1969. The amplitude of the anisotropy reduces to about one half or more in 1969 compared to that in 1968. The energy spectrum of this anisotropy seems to show a positive exponent with an upper limiting energy E_{max} of 55–85 GeV. The results are discussed in terms of the cosmic ray density gradients during this period. (auth)

19563 (CONF-730804-P2, pp 993-998) THREE-DIMENSIONAL COSMIC-RAY ANISOTROPY IN INTERPLANETARY SPACE RESPONSIBLE FOR SOLAR SEMI-DIURNAL VARIATION. Fujimoto, K.; Nagashima, K.; Ueno, H.; Kondo, I. (Nagoya Univ., Japan). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Cosmic ray anisotropy was analyzed by the least squares method on the solar rotation basis, using data observed by the multi-directional meson telescope at Mt. Norikura (Nov. 1968–July 1971). The analysis reconfirmed the previous conclusion that the anisotropy has a loss cone distribution with a reference axis being in the direction of interplanetary magnetic line of force. The solar-ecliptic longitude of the reference axis did not change drastically from the average (-45° or 135°) during this period. While its latitude showed a systematic deviation from the average (0°) to 10°S sunward in 1970. This suggests that the average direction of magnetic line of force within a distance of ~0.5 A.U. from the earth deviated from the ecliptic plane in 1970. (auth)

19564 (CONF-730804-P2, pp 999-1004) DIURNAL VARIATION CHARACTERISTICS ON A DAY TO DAY BASIS. Ananth, A. G.; Agrawal, S. P.; Rao, U. R. (Physical Research Lab., Ahmedabad, India). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

From a careful examination of the diurnal variation of cosmic ray intensity at high energies and the interplanetary field characteristics, the average characteristics of diurnal variation was recently explained in terms of a balance between outward convection and field aligned diffusion, the latter arising out of a positive radial density gradient. In this paper we extend this new concept to explain the large variability observed in the diurnal variation on a day to day basis. Comparing with the magnetic field vector, we show that this simple concept holds good on more than 80% of days. On the rest of 20% of days which have a predominant morning maxima, the diurnal anisotropy characteristics seem to indicate the presence of a transverse diffusion current in addition to the normal convection and diffusion flow. Such days are found to be present in the form of trains of consecutive days, often occurring immediately following a significant change in the direction of the observed interplanetary magnetic field. (auth)

19565 (CONF-730804-P2, pp 1005-1010) AVERAGE CHARACTERISTICS OF COSMIC-RAY DIURNAL ANISOTROPY AT RELATIVISTIC ENERGIES. Agrawal, S. P.; Ananth, A. G. (Physical Research Lab., Ahmedabad, India). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Even though the time of maximum of the diurnal anisotropy of cosmic radiation obtained from neutron monitor observations has been found to be practically invariant with time during the period 1957–1970, monitors responding to higher energies have always indicated a significant change in both the diurnal time of maximum and the amplitude. However, the recent neutron observations have shown a significant phase shift to earlier hours in the diurnal time of maximum during 1971–1972, which is found to be larger for low latitude stations as compared to middle and high latitude stations. The analysis shows that the observed shift in the time of maximum cannot be attributed to a reasonable change in the value of the upper cut-off-rigidity. Further the diurnal amplitude, in general, seems to be time invariant during the period 1968–1972. An attempt has been made to discuss these results in terms of the existing theories of the long term change in the diurnal variation of cosmic ray intensity. (auth)

19566 (CONF-730804-P2, pp 1011-1015) SIDEREAL DAILY VARIATION MEASURED BY HIGHLY INCLINED TELESCOPES AT 60 m.w.e. DEPTH IN LONDON. Dutt, J. C.; Marsden, R. G.; Speller, R. D.; Thambyahpillai, T. (Imperial Coll., London). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

There are three mutually contradictory points of view regarding the sidereal diurnal variation measured underground at depths of a few to several tens of meters water equivalent. One school holds that the effect at all depths is caused by solar modulation while a second one regards it to be totally genuine and caused by a bidirectional galactic anisotropy. A third school regards the sidereal variation to be spurious at the shallower depths but genuine at greater depths and the genuine effect to be caused by the solar motion relative to nearby stars. While the first two schools expect an underground telescope with an equatorial scan to register no sidereal diurnal variation (but perhaps a semi-diurnal variation) the third school expects a deep telescope to register an even larger sidereal diurnal variation than at middle latitudes. Thus equatorial measurements can help verify or reject the third school of thought. Cubical telescopes tilted at 70° to the vertical and pointing due south have been operating at 60 m.w.e. vertical depth in London for one year. The zenith angle was chosen so as to make the direction of maximum sensitivity of the telescopes point into the earth's equatorial plane. The data have been analyzed in solar, sidereal and anti-sidereal times and the only dominant feature is a semi-diurnal variation in solar time. The first and second harmonics of the sidereal daily variation are about equal in amplitude and not much larger than the standard deviations which are a measure of the statistical fluctuations. It is pointed out that if the strong second harmonic in solar time were confirmed by further measurements, corrections have to be applied for spurious sidereal second harmonics arising from a six-monthly modulation of the solar semi-diurnal effect. (auth)

19567 (CONF-730804-P2, pp 1016-1021) COSMIC-RAY DENSITY GRADIENTS AT HIGH RIGIDITIES. Swinson, D. B. (Univ. of New Mexico, Albuquerque). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Data from three underground mu-meson telescopes at Bolivia, Embudo and Socorro at depths of 25, 40 and 80 m.w.e., respectively, have been analyzed as a function of the direction of the interplanetary magnetic field for the three years 1968, 1969, and 1970. From this analysis the $\vec{B} \times \nabla N$ cosmic ray anisotropy is determined as a function of magnetic field direction for the three telescopes whose threshold rigidities are 17, 30, and 52 GV, respectively. Analysis of data in solar time gives information about the cosmic ray density gradient perpendicular to the ecliptic plane, while analysis in sidereal time gives information on the radial heliocentric cosmic ray density gradient. It is found that the cosmic ray anisotropies resulting from both the radial and perpendicular gradients are still quite evident above 52 GV, and that the radial gradient appears to decrease faster with increasing rigidity than does the perpendicular gradient. (auth)

19568 (CONF-730804-P2, pp 1022-1027) OBSERVATIONS OF COSMIC-RAY INTENSITY VARIATION AT 50 m.w.e. UNDERGROUND SINCE 1971. Ichinose, M.; Mori, S.; Yasue, S. (Shinshu Univ., Matsumoto, Japan). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Continuous observations have been made since 1971, with multi-directional muon telescope having an area of 8 m^2, at a vertical depth of 50 m.w.e. underground at Matsumoto. The telescope consists of five sub-telescopes of two layers separated by 125 cm, thus can measure the cosmic-ray intensity for five directions of North (N), South (S), East (E), and West (W), as well as for Vertical (V). Observed counting-rates are about 6×10^4/hr for V (50 m.w.e.), 3.4×10^4/hr for N (42 m.w.e.), 0.85×10^4/hr for S (92 m.w.e.), 1.1×10^4/hr for E (65 m.w.e.), and 1.5×10^4/hr for W (53 m.w.e.). Barometric coefficients were obtained, which are in good agreement with other authors. By utilizing two years data, and by taking difference such as S–N, E–N, W–N, and V–N, it is shown that average diurnal and semi-diurnal anisotropies in space are consistent with those already reported. (auth)

19569 (CONF-730804-P2, pp 1028-1031) DAILY VARIATIONS OF COSMIC RAYS OBSERVED AT 54 m.w.e. UNDERGROUND. Murakami, K. (Inst. of Physical and Chemical Research, Tokyo); Wada, M.; Miyazaki, Y.; Mishima, Y. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

A multi-directional cosmic ray telescope has been in operation since 1968 at a depth of 54 m.w.e. underground in Takeyama, Japan. Daily variations were obtained on the intensities in vertical and east, west, south, and north at zenith angle 30°. Assuming the effective primary rigidity of 100 GV, the anisotropies in solar time projected to the earth's equatorial plane are

	Amplitude (%)	Time of max. (hr)
First harmonic	0.061 ± 0.017	13.2 ± 1.1
Second harmonic	0.039 ± 0.006	2.7 ± 0.3
Third harmonic	0.019 ± 0.009	6.6 ± 0.7

The result on the projected anisotropies in sidereal and anti-sidereal time also were obtained from the observation in five incident directions. (auth)

19570 (CONF-730804-P2, pp 1032-1039) STUDIES OF MAGNETOSPHERIC AND INTERPLANETARY COSMIC-RAY VARIATIONS IN MAY–JUNE 1972. Dorman, L. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow); Dvornikov, V. M.; Luzov, A. A.; Sergeev, A. V.; Yanchakovskii, A. L. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The Irkutsk spectrograph data (R_c = 3.8 GV) are used to study in detail two cases of cosmic ray Forbush-decreases in May and June 1972. The ring current parameters are estimated on the basis of the available data on the geomagnetic cut-off rigidity changes and the value of geomagnetic field depression (according to D_{st}-variation). The cosmic ray intensity recovery after a Forbush-decrease has been shown to be mainly due to the cosmic ray diffusive flux along the interplanetary magnetic field force lines. The anomalous cosmic ray intensity increase during the Forbush-effect in June 1972 is analyzed. The anomalous increase is shown not to relate to the effect of the geomagnetic cut-off rigidity change. (auth)

19571 (CONF-730804-P2, pp 1040-1044) 24-, 12-, AND 8-HOUR COSMIC-RAY ANISOTROPY VARIATIONS IN INTERPLANETARY SPACE. Asylbaeva, S. D.; Gonchar, G. A.; Kolomeets, E. V.; Mirkin, L. A.; Slunaeva, N. V. (Kazakh State Univ., Alma-Ata, USSR). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

It is shown that during the period 1958–1970 the solar anisotropy amplitude increases from minimum to maximum by about 30% and time of maximum remains constant within the accuracy of ∓1 hour. Twenty percent of the enhancement is found to be caused by the change of solar activity. The amplitude of the semidiurnal variation is (0.04 ∓ 0.01)% and the phase lies between 2.5 and 4.0 hour. They do not change in a definite manner during the cycle of solar activity. The third harmonic is found to have an amplitude of 0.017%, a phase of (1.0 ± 0.5) hour, and an energy spectrum of the form $\alpha E^{0.3 \mp 0.1}$. Parameters of anisotropy determined on a day-to-day basis fluctuate significantly. These fluctuations are associated mainly with the changes of the drift velocity of the cosmic ray flux. (auth)

19572 (CONF-730804-P2, pp 1045-1051) SURFACE AND UNDERGROUND MEASUREMENTS OF LONG-TERM CHANGES IN THE COSMIC-RAY SOLAR DIURNAL VARIATION. Thambyahpillai, T. (Imperial Coll., London); Speller, R. D.; Peacock, D. S. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol 2.

Vertical and inclined telescopes operating at a depth of 60 m.w.e. underground and north/south directional telescopes operating at the surface in London have been employed to study changes in the cosmic ray solar diurnal variation over the past few years. Taken jointly, the data lead to the conclusion that the upper limiting rigidity associated with a rigidity-independent azimuthal streaming of the cosmic ray gas (in the interplanetary magnetic field) is reduced during times of low solar activity and increases with increasing solar activity. This change may form the chief basis of the component with a period of a single solar cycle in the long-term changes of the diurnal variation. The underground data require that the component due to atmospheric temperature effects is negligibly small and that throughout the rigidity range covered by the recorder response, there is present an apparent anisotropy due to the orbital motion of the earth around the sun. The surface data require that the free-space amplitude of the anisotropy due to azimuthal streaming be as large as 0.54% and not as low as 0.40%. It is pointed out that the 128° east component which has a dominant periodicity of two solar cycles and which was first isolated by Forbush can be identified with the theoretically expected diffusive component of the anisotropy. A method is suggested for preventing this identification from leading to the result that the radial density gradient of the cosmic ray gas reverses sign during alternate solar cycles. (auth)

19573 (CONF-730804-P2, pp 1052-1057) LONG-TERM VARIATION IN THE COSMIC-RAY ANISOTROPIES. Iucci, N.; Parisi, M.; Storini, M.; Villoresi, G. (CNR, Rome). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The long-term modulation of the diurnal variation is fully explained by the change in the interplanetary sector pattern, which generate an upper rigidity cut-off increasing from ~50 GV (1965) to ~150GV (1968). The amplitude of the diurnal variation is largely reduced in periods of mixed polarities of the magnetic field. The North–South anisotropy, whose sign follows the field polarity, seems to be generated by the cosmic ray radial gradient. Estimates of the change of this gradient from 1965 to 1968 are in agreement with the changes in the interplanetary magnetic structure. (auth)

19574 (CONF-730804-P2, pp 1058-1063) SIDEREAL TIME VARIATION OF SMALL AIR SHOWERS OBSERVED AT MT. NORIKURA. Sakakibara, S.; Ueno, H.; Fujimoto, K.; Kondo, I.; Nagashima, K. (Nagoya Univ., Japan). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Observation of small air showers was continued from August 1970 to December 1972, utilizing the upper layer of the multidirectional large area cosmic ray telescope at Mt. Norikura. The counting rate of the selected events, which are 3-fold coincidences out of four trays (4 m^2 each), is 45,000 counts/hour and the median energy was estimated as $\sim 5 \cdot 10^{13}$ eV. After correcting for barometric effects (−0.7 %/mb), the result of the observation showed a statistically significant sidereal diurnal anisotropy of amplitude 0.047 ± 0.006% and maximum at 1.3 ± 0.7 h, which is hard to interpret by atmospheric temperature effects. (auth)

19575 (CONF-730804)P2, pp 1064-1069) COSMIC-RAY DATA IN WORLD DATA CENTERS. Lincoln, J. V. (World Data Center A for Solar-Terrestrial Physics, Boulder, CO); Shea, M. A. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The international exchange of cosmic ray data is facilitated through the use of the World Data Center System. The cosmic ray data available at World Data Center A for Solar-Terrestrial Physics, NOAA, Boulder, Colorado 80302, USA, will be presented in detail. Their use and availability will be given. Especially noteworthy for cosmic ray data publication are the UAG-Reports of WDC-A on Outstanding Solar-Geophysical Events. Through these reports the cosmic ray data reach a wide audience. The developments under the Monitoring of the Sun–Earth Environment (MONSEE) program of the ICSU Special Committee on Solar-Terrestrial Physics will also be given. A MONSEE Quarterly is planned and will be published in STP NOTES presenting changes in programs, establishment of new stations, and the like. The Guide for International Data Interchange in Solar-Terrestrial Physics presents recommendations for cosmic ray data interchange. (auth)

19576 (CONF-730804-P2, pp 1070-1074) EMPIRICAL METHOD OF ESTIMATING CUTOFF RIGIDITIES AT SATELLITE ALTITUDES. Smart, D. F.; Shea, M. A. (Air Force Cambridge Research Labs., Bedford, MA). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

An empirical method of estimating cutoff rigidities at satellite altitudes has been developed by using the L-parameter as an interpolation aid. This involves an extrapolation of the cut-off rigidity at a specific location to a position at a higher altitude but along the same geocentric radial vector. Cutoff rigidities for angles other than vertical can be estimated by using the dipolar geometry of the R–λ coordinates about the eccentric dipole in the Stormer equation. A comparison of trajectory-derived cutoffs with those derived by this empirical method show sufficient agreement for many practical applications. (auth)

19577 (CONF-730804-P2, pp 1075-1080) TRANSMITTANCE FUNCTIONS FOR DEFINING THE RESPONSE OF A COSMIC-RAY DETECTOR IN THE GEOMAGNETIC FIELD. Shea, M. A.; Smart, D. F.; Moomey, W. R. (Air Force Cambridge Research Labs., Bedford, MA). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

A transmittance function is the evaluation of the fraction of allowed trajectories at a specified rigidity that can be detected by a cosmic-ray experiment possessing a finite solid angle of acceptance. The transmittance function defined in this paper is an attempt to consider cosmic-ray cutoffs from the viewpoint of an experimentalist who wishes to estimate the response of a cosmic-ray detector at a specific location. While the initial derivation of this function involves extensive computer calculations of cutoff rigidities as a function of zenith and azimuth angles, it is shown that Stormer theory can be used to give an empirical derivation of this transmittance function after appropriate normalization to a trajectory-derived vertical cutoff rigidity. (auth)

19578 (CONF-730804-P2, pp 1082-1087) COSMIC-RAY PARTICLES WITH LOW RIGIDITIES AT TEXAS, USA. Larsson, L.; Andersson, R.; Mathiesen, O. (Univ. of Lund, Sweden). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

From 13th international cosmic ray conference. Vol. 2.

By means of photometric measurements in Ilford G5 nuclear emulsions the velocity and charge number $Z \geq 18$ has been determined for cosmic ray particles ray particles registered at a balloon flight conducted from Palestine, Texas. Particles with zenith angles up to 65 degrees have been recorded. The experimental

rigidity spectrum is found to extend down to about 3 GV at the top of the atmosphere, in excellent agreement with the calculations by Shea and Smart. Intensity values for two particle groups are reported. The implications of the low cutoff rigidity on the heavy cosmic ray charge spectrum are briefly discussed. (auth)

19579 (CONF-730804-P2, pp 1102-1107) INFLUENCE OF THE INTERPLANETARY MAGNETIC FIELD SECTOR STRUCTURE ON THE GALACTIC COSMIC-RAY MODULATION. Bazilevskaya, G. A.; Okhlopkov, V. P.; Charakhchyan, T. N. (Lebedev Inst. of Physics, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The results of every day stratospheric measurements and the neutron monitor data were analyzed by the power spectrum method to investigate the time fluctuations of cosmic ray intensity. The peaks exceeding the 95% level of significance with periods of about 14, 9, and 7 days were found using statistics of 91, 182, and 365 daily values. These periods fit to spatial dimension of sectors of interplanetary magnetic field. The same periods are distinguished at the power spectra of geomagnetic activity. Amplitudes of observed cosmic ray variations agree with the results obtained by the method of superposition of epochs beginning at the day of Earth crossing of the sector boundary. (auth)

19580 (CONF-730804-P2, pp 1116-1121) LONG-TERM BEHAVIOR OF VH COSMIC RAYS AS OBSERVED IN LUNAR ROCKS. Yuhas, D.; Walker, R. (Washington Univ., St. Louis). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The depth dependence of fossil tracks in particularly favorable lunar rocks has been used to investigate the constancy of galactic very heavy nuclei. When dynamic lunar surface processes are taken into account, it is concluded that both the spectral shape and the absolute flux has not changed significantly over the past 50 million years. (auth)

19581 (CONF-730804-P2, pp 1122-1128) RADIOCARBON CONTENT IN THE EARTH'S ATMOSPHERE AND COSMIC-RAY TIME VARIATIONS. Dergachev, V. A.; Kocharov, G. E. (Ioffe Inst. of Physics and Tech., Leningrad). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The theoretical and experimental principles of a new approach to the study of cosmic-ray time variations for the last tens of thousands years are discussed. Consideration is successively given to the problems of correlation between the radiocarbon concentration in the terrestrial atmosphere and time variation and inversion of geomagnetic field; flares of supernovae; the cyclic and burst activity of the Sun. (auth)

19582 (CONF-730804-P2, pp 1129-1134) EVIDENCE FOR EMISSION OF COSMIC RAYS BY JUPITER. Pizzella, G.; Venditti, G. (CNR, Rome). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Cosmic ray data obtained with a world neutron monitor network have been analyzed with the purpose to investigate whether Jupiter is a cosmic ray source. The data cover the period 1961 through 1965 for stations with cutoff energy above 6.3 GeV. Strong evidence is found that the cosmic ray flux is nearly 1% larger for a preferred direction which remains invaried in a reference system corotating with Jupiter. (auth)

19583 (CONF-730804-P2, pp 1135-1140) COSMIC-RAY HYSTERESIS AS EVIDENCE FOR TIME-DEPENDENT DIFFUSIVE PROCESSES IN THE LONG-TERM SOLAR MODULATION. O'Gallagher, J. J. (Univ. of Maryland, College Park). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

A simple one-dimensional time-dependent diffusion-convection model for the modulation of cosmic rays is presented. This model predicts that the observed intensity $U(t_0)$ at a given time t_0 is approximately equal to the intensity given by the time independent diffusion convection solution under interplanetary conditions which existed a time τ in the past, $[U(t_0) \approx U_s(t_0 - \tau)]$, where τ is the average time spent by a particle inside the modulating cavity. Delay times in excess of several hundred days are possible with reasonable modulation parameters. Interpretation of phase lags observed during the 1969-1970 solar maximum in terms of this model suggests that the modulating region is probably not less than 10 a.u. and maybe as much as 35 a.u. in extent. (auth)

19584 (CONF-730804-P2, pp 1141-1148) RELATION OF COSMIC-RAY MODULATION TO SOLAR-WIND PARAMETERS AND SOLAR ACTIVITY WITHIN THE FRAME OF THE CONVECTIVE-DIFFUSION MODEL. Zusmanovich, A. G.; Kolomeets, E. V.; Chumbalova, R. A. (Kazakh State Univ., Alma-Ata, USSR). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The relation of changes in the cosmic ray intensity and the modulation coefficient to solar wind parameters and solar activity are analyzed for 1964-1968. The obtained empirical expressions are compared with relationships resulting from the diffusion-convection theory of the cosmic ray modulation in interplanetary space. The experimental observations are shown to be consistent with the theoretical predictions from the diffusion-convection model. (auth)

19585 (CONF-730804-P2, pp 1149-1158) STUDIES OF THE 11-YEAR COSMIC-RAY VARIATION BY SPECTROGRAPHY METHOD. Dorman, I. V. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow); Dorman, L. I.; Dvornikov, V. M.; Sergeev, A. V. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The 11-year variation energy spectrum is determined by the spectrography method on the basis of the data of observations of various cosmic ray secondary components at various altitudes using experimental expedition measurements and stratospheric observations. The results obtained are compared with the direct measurement data from interplanetary space and interpreted on the basis of the theory of the galactic cosmic ray interaction with the spectrum of solar wind magnetic inhomogeneities moving away from the sun. (auth)

19586 (CONF-730804-P2, pp 1159-1164) ANOMALOUS EFFECT IN THE 11-YEAR GALACTIC COSMIC-RAY MODULATION. Charakhchyan, A. N.; Stozhkov, Yu. I.; Svirzhevskii, N. S.; Charakhchyan, T. N. (Lebedev Inst. of Physics, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The 11-year cosmic ray modulation, N, in the stratosphere (altitudes of 20-23 km) almost repeats the cycle of sunspot formation and is controlled by solar activity in terms of the spot group number (η) and the mean heliolatitude of the spots (φ). However, since the middle of 1971 this long-year relation between N and solar activity has been almost completely violated: N is rapidly increasing irrespective of solar activity. The effect seems to be difficult to correlate with the usual mechanism of the 11-year cosmic ray modulation by solar wind (Parker's mechanism). An attempt is made to relate the effect to the process of the 22-year cycle of the general (dipolar) solar magnetic field the magnetic moment of which passes probably through zero or decreases abruptly in 1971-1973. (auth)

19587 (CONF-730804-P2, pp 1166-1171) SOLAR ACTIVITY AND COSMIC-RAY MODULATION IN CYCLES No. 19 AND No. 20. Iucci, N.; Parisi, M.; Storini, M.; Villoresi, G. (CNR, Rome). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The short-term modulation (Forbush decreases) is found to be well correlated with the frequency of solar flares and with the intensity of the 5303 Å emission at middle heliolatitudes (~15°-40°), while, as already found, the quasi-stationary solar cycle modulation is well correlated with the λ5303 intensity about the solar equator (~0°-15°). The different time behavior of the solar activity at different heliolatitudes seems to be responsible for the time changes of the rigidity dependence of the cosmic ray modulation observed in cycle No. 20. (auth)

19588 (CONF-730804-P2, pp 1172-1177) SOLAR ACTIVITY EFFECT ON THE SPATIAL AND TIME COSMIC-RAY DISTRIBUTION IN INTERPLANETARY SPACE. Dorman, L. I.; Gushchina, R. T. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The effect of the solar activity heliolatitude distribution on cosmic ray intensity variations is studied. A combined index, HL, is inserted which includes the solar activity heliolatitude distribution at various functions of the effective influence of solar active regions on cosmic ray distribution in interplanetary space. The

above mentioned functions are selected on the basis of analysis of theoretical models of cosmic ray diffusion in the solar wind magnetic fields. Comparison of the theoretically expected spatial and time cosmic ray distributions with experimental data yields information on the various characteristics of solar wind. (auth)

19589 (CONF-730804-P2, pp 1190-1195) SUNSPOTS, CORONAL STREAMERS, AND LONG-TERM MODULATION. Parker, G. D. (Univ. of Denver). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The long-term variation of the nucleonic flux during 1964–1967 is anticorrelated with both sunspot number and the brightness of the solar electron corona at one-half solar radius above the limb. That the K-coronal index is significantly better correlated with long-term modulation than is sunspot number suggests that the morphology of coronal magnetic fields is related to the generation of cosmic ray scatterers in interplanetary space. The median time lag of long-term modulation behind coronal activity is 23 days, but this interval is too poorly defined statistically to be useful in estimating the size of the modulation region for GeV primaries. (auth)

19590 (CONF-730804-P2, pp 1196-1202) 27-DAY RECURRENT COSMIC-RAY MODULATION AND LONG-LIVED SOLAR DISTURBANCES. Parker, G. D. (Univ. of Denver). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The relationship between the short-term modulation of GeV galactic cosmic radiation and solar activity is studied by means of correlation analysis. Coronal structures not necessarily related to sunspot activity lower in the solar atmosphere are interpreted as indicators of regions in the solar wind where cosmic ray scattering occurs. A model proposed to account for the 7-day lag of nucleonic flux depressions behind the central meridian passage of active regions may also explain the 11-year variation of the cosmic ray flux. (auth)

19591 (CONF-730804-P2, pp 1204-1206) POSSIBLE MODULATION OF THE COSMIC-RAY INTENSITY BY JUPITER. Castagnoli, G. C.; Dodero, M. A.; Giraud, C. (Univ., Turin). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

A search on the upper limit of the energy of a possible Jupiter-accelerated component of the cosmic ray intensity has been performed. Underground data from Hobart, London and Torino stations over the period 1966–1969 have been analyzed according to a daily variation around the reference hour in which the Stations look towards Jupiter. The results are not conclusive because observations during a 12 years period of Jupiter rotation around the Sun should be considered. (auth)

19592 (CONF-730804-P2, pp 1207-1211) LONG-TERM VARIATIONS IN COSMIC RAYS AND SOLAR ACTIVITY. Kolomeets, E. V.; Mukanov, J. B.; Shvartsman, Ya. E. (Kazakh State Univ., Alma-Ata, USSR). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The cosmic ray variation amplitudes with periods of 40-1120 days in the interval 1957–1972 are calculated. The periods of the variations revealed are identified with those of rotation of Mercury, Venus, Earth, and Mars around the Sun. The variations with periods of 160–180 days and 460–500 days are found as well. The same periods are established for variations of the solar activity with green coronal line intensity (λ = 5303 A) as its index. To interpret the obtained results the dependence of the second and the third derivatives on the distance between the center of the Sun and the centers of masses of the planets of Mercury, Venus, the Earth, and Mars are calculated. The peaks of the second and the third derivatives occur at the same periods as that of the cosmic ray intensity and solar activity. The energy spectra of the observed variations in a power-law form with exponent $\gamma \approx 0.5 + 1$ are calculated. (auth)

19593 (CONF-730804-P2, pp 1212-1217) COMPARISON OF CONNECTION OF 27-DAY AND 11-YEAR COSMIC-RAY VARIATIONS WITH PARAMETERS OF SOLAR ACTIVITY. Bazilevskaya, G. A.; Okhlopkov, V. P.; Charakhchyan, T. N. (Lebedev Inst. of Physics, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Analysis of 27-day cosmic ray intensity variations and solar activity in 1957–1972 has shown that the most pronounced relation between these phenomena can be observed during the periods of comparatively low solar activity (1961–1967) whereas during a solar maximum the relation is feeble. It follows from the relation of 27-day and 11-year variation amplitudes that the region of spatial symmetry in solar wind is only 0.1–0.3 of the 11-year modulation region. (auth)

19594 (CONF-730804-P2, pp 1218-1224) HIGH-ENERGY SPECTRA OF THE 11-YEAR, 27-DAY, AND SOLAR-DIURNAL COSMIC-RAY VARIATIONS AND FORBUSH DECREASES ACCORDING TO THE UNDERGROUND OBSERVATION DATA. Bishara, A. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow); Dorman, L. I. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

High-energy spectra of the observed 11-year, 27-day, and solar-diurnal cosmic ray variations and Forbush-Decreases are determined on the basis of the relations between these variations at depths of 0.7 and 20 m.w.e. Four types of the spectra are tried. The power exponents, spectrum knees, and peak energies have been found for each of the above variation types. (auth)

19595 (CONF-730804-P2, pp 1227-1231) FORBUSH DECREASE ANALYSIS DURING THE PERIOD 1965–1972. Aldagarova, H. Z.; Kolomeets, E. V.; Musabaev, M. A.; Pivneva, V. T. (Kazakh State Univ., Alma-Ata, USSR). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

An analysis of Forbush decreases is carried out for the period from 1965 to 1972. The variation energy spectra are calculated by taking into account the influence of the variation of the geomagnetic cutoff. It is found that the form of the energy spectra of Forbush decreases is independent of their amplitudes and solar activity. The rate of the intensity decrease of FD is shown to be dependent on the shock wave velocity in agreement with Parker's model. (auth)

19596 (CONF-730804-P2, pp 1233-1239) GALACTIC COSMIC-RAY PROPAGATION IN INTERPLANETARY SPACE IN THE PRESENCE OF A STRONG SHOCK WAVE. Dorman, L. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow); Shogenov, V. Kh. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Cosmic ray reflection from a strong bow shock ("magnetic mirror") has been examined on the basis of a kinetic equation. The expected cosmic ray intensity changes have been determined on some simplifying assumptions. Angular distribution, energy spectrum, and the total number of particles reflected from a strong shock wave surface have been calculated. The expected effect of cosmic ray intensity increase for ground observations has been found. Comparison with experimental evidence is presented. (auth)

19597 (CONF-730804-P2, pp 1240-1246) SHOCK-WAVE STUDIES ON THE BASIS OF THE INCREASE EFFECT BEFORE FORBUSH DECREASE. Dorman, L. I.; Kaminer, N. S.; Kuzmicheva, A. E. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Consideration is given to the increase effect as observed at the northern and southern high-latitude stations. The local time dependence of the increase effect is studied for a ring of stations at various times prior to Forbush-decrease commencement. The Forbush-decrease and preceeding intensity increase are shown to be due to a shock wave generated at a noticeable distance from the Sun. The form of the shock wave front for the Forbush-decrease of May 14, 1969 is determined. (auth)

19598 (CONF-730804-P2, pp 1247-1255) STUDIES OF ISOTROPIC AND ANISOTROPIC COSMIC-RAY VARIATIONS IN THE EARTH'S VICINITIES DURING DISTURBED PERIODS. Belov, A. V.; Blokh, Ya. A.; Dorman, L. I.; Eroshenko, E. A.; Inozemtseva, O. L.; Kaminer, N. S. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Isotropic and anisotropic cosmic ray variations in the Earth's vicinities are studied on the basis of the data from the worldwide

network of neutron monitors. A method is proposed for isolating the first spherical harmonic of anisotropy on the assumption of power spectrum. Two disturbed periods are studied in details: October–November, 1968 and August, 1972. (auth)

19599 (CONF-730804-P2, pp 1256-1260) SIMULTANEOUS VARIATIONS OF COSMIC-RAY CURRENT AND INTERPLANETARY MAGNETIC FIELD. Altukhov, A. M.; Krymskii, G. F.; Kuzmin, A. I.; Samsonov, I. S. (Inst. of Cosmophysical Research and Aeronomy, Yakutsk, USSR). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The results of direct interplanetary magnetic field measurements are compared with the observations of galactic cosmic ray current. It is shown that in those cases when these values reveal a relation it can be understood in terms of the anisotropic diffusion mechanism. Estimations show that during the longer of the observation time the ratio of the transverse diffusion coefficient to the longitudinal one is close to 0.2. At some periods this ratio decreases to 0.02-0.05. (auth)

19600 (CONF-730804-P2, pp 1261-1265) HELIOLONGITUDE OF THE ACTIVE REGIONS AND THE TIME BEHAVIOR OF THE ASSOCIATED FORBUSH DECREASES. Iucci, N.; Parisi, M.; Storini, M.; Villoresi, G. (CNR, Rome). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The average time behavior of a Forbush decrease is found to be dependent on the heliolongitude of the associated solar flare. The Forbush decrease seems to corotate with the sun, suggesting the existence of closed magnetic lines of force, connected to the sun, which surround the region of interplanetary space involved in the Forbush decrease. (auth)

19601 (CONF-730804-P2, pp 1266-1270) LONG AND SHORT TERM MODULATION IN SOLAR CYCLE NO. 20. Iucci, N.; Parisi, M.; Storini, M.; Villoresi, G. (CNR, Rome). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

To investigate the cosmic ray modulation in solar cycle No. 20, the plots between high and low energy intensities are used. The observed "step-like" modulation seems to be produced by the overlapping between the Forbush decrease and the quasi-stationary solar-cycle modulation, at least at energies of ground-based detectors. After elimination of Forbush decrease days, the only step-like change still remaining is that at the middle of 1969. Instrumental instabilities in high-energy monitors makes uncertain the existence of such a discontinuity at the investigated energies, while it is observed at very low energies. (auth)

19602 (CONF-730804-P2, pp 1271-1276) FORBUSH DECREASES, 1966–1972: THEIR SOLAR AND INTERPLANETARY ASSOCIATIONS AND THEIR ANISOTROPIES. Barnden, L. R. (National Research Council of Canada, Ottawa). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The available solar and interplanetary data at times of large Forbush decreases is summarized, and some early results from a survey being conducted on the 3-dimensional nature of the anisotropies associated with Forbush decreases are presented. Attention is restricted to that population of Forbush decreases >4% in amplitude which occurred between 1966 and 1972. (auth)

19603 (CONF-730804-P2, pp 1277-1282) LARGE-SCALE MAGNETIC FIELD CONFIGURATION ASSOCIATED WITH FORBUSH DECREASES. Barnden, L. R. (National Research Council of Canada, Ottawa). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Two-step Forbush decreases provide direct evidence for a double structure within the associated interplanetary disturbance near its axis. It is proposed that this double structure is a driven shock where the shock front is associated with the first step and the driver gas surface the second. This is supported by the solar wind and magnetic field data. Two magnetic field configurations consistent with a driven shock are considered. While both can account for most of the cosmic ray observations, only the bottle type configuration can satisfactorily explain the step decrease in cosmic ray intensity at the driver gas seen in 2-step Forbush decreases and energetic storm particle events; and field aligned bidirectional anisotropies within the driver gas. A model for the number density distribution consistent with this field configuration and the observed Forbush decrease dependence on parent flare longitude is proposed. (auth)

19604 (CONF-730804-P2, pp 1284-1288) DISTINCT LOSS CONE IN COSMIC-RAY FLOW WHICH LIVED THREE DAYS, FEBRUARY 5–7, 1968. Wada, M.; Kudo, S. (Inst. of Physical and Chemical Research, Tokyo). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

After the onset of a small Forbush decrease on February 4, 1968, clear decreases appeared until February 7, and then suddenly vanished. At the beginning, the direction corresponding to the decrease was perpendicular to the interplanetary magnetic field. Through the period, the direction changed to parallel to the field. The former can be accounted for lower density region behind the blast wave which triggered the Forbush decrease, but with axis 0.3 AU north of the earth. The latter is a typical example of the loss cone along the field, but the spectrum is softer than those reported so far. (auth)

19605 (CONF-730804-P2, pp 1289-1292) FORBUSH DECREASES OBSERVED AT 54 m.w.e UNDERGROUND. Mishima, Y. (Ehime Univ., Matsuyama, Japan); Murakami, K.; Wada, M.; Miyazaki, Y. 1973.

From thirteenth international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Forbush decreases are investigated by using cosmic ray data observed at ground-level stations as well as at a depth of 54 m.w.e. underground in Takeyama, Japan. The variation spectrum of the average of thirteen Forbush decreases during three years 1969–1971 is represented by a power law of an exponent –0.9 with a cutoff at rigidity 100 GV or 200 GV. In individual cases, some Forbush decreases are explained by the variation spectra with the exponent of –0.5 which extends to higher rigidity. Therefore, it seems that there are severe fluctuations of the exponent and high cutoff rigidity from decrease to decrease. (auth)

19606 (CONF-730804-P2, pp 1293-1297) DIURNAL ANISOTROPY OF COSMIC RAYS ASSOCIATED WITH FORBUSH DECREASES AND SOLAR FLARES. Bemalkhedkar, M. M. (Physical Research Lab., Ahmedabad, India); Subramanian, G.; Razdan, H. 1973.

From thirteenth international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In thirteenth international cosmic ray conference. Vol. 2.

The diurnal anisotropy in the cosmic ray intensity during the recovery phase of recurrent Forbush decreases, is found to have an association with solar flares of importance 2 and greater preceding the decrease. Whereas the anisotropy associated with west limb flares is along the 18 hour direction in the interplanetary space, it is found to be mostly along the garden hose direction when the Forbush decrease is preceded by an east limb flare. The amplitude of the anisotropy along the garden hose direction further shows an inverse correlation with the cosmic ray mean intensity level during the recovery of the Forbush decrease. (auth)

19607 (CONF-730804-P2, pp 1298-1303) MODULATION OF LOW-ENERGY GALACTIC COSMIC RAYS. Van Hollebeke, M. A. I.; Wang, J. R.; McDonald, F. B. (Goddard Space Flight Center, Greenbelt, MD). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Detailed observations of low energy galactic protons and helium nuclei (~60 MeV/nucleon) have been made for the period extending from June 1967–December 1972. A significant time lag between intensity changes in the low energy and high energy components for the 1969-1971 period had been reported previously. Extending these observations it is found that this "hysteresis loop" is closed in early 1972 with the protons lagging significantly behind the helium component at 60 MeV/nucleon. At this time the cosmic ray flux levels had returned to the level previously observed during the 1965 solar minimum period. However after March 1972 significant change in the modulation has been observed in the low energy component. These results will be compared with the results of existing modulation theory. (auth)

19608 (CONF-730804-P2, pp 1304-1309) ANOMALOUS 1972 LOW-ENERGY GALACTIC COSMIC-RAY PROTON AND HELIUM SPECTRA. Garcia-Munoz, M.; Mason, G. M.; Simpson, J. A. (Univ. of Chicago). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Current models of solar modulation can fit satellite observations <100 MeV per nucleon from the 1965-1969 period which

showed the effects of increasing modulation, and the 1969-1971 period which included phase lag effects during the recovery phase of the current solar cycle modulation. However, in mid-1972, the low energy galactic proton and helium spectra, measured by the University of Chicago IMP-5 satellite experiment, evolved into forms which challenge the previously successful assumptions used in solving the Fokker-Planck equation describing the modulating process. The 1972 proton spectrum was seen to have a characteristic rising slope in the interval 30-100 MeV, while the helium spectrum showed a new feature: a flux essentially independent of kinetic energy below 80 MeV per nucleon. The evolution of these spectra through late 1972 are presented, and the implications for solar modulation theory are discussed. (auth)

19609 (CONF-730804-P2, pp 1311-1316) ENERGY SPECTRA OF ELEVEN-YEAR VARIATIONS OF THE COSMIC-RAY INTENSITY AS MEASURED IN THE STRATOSPHERE. Svirzhevskaya, A. K.; Stozhkov, Yu. I.; Charakhchyan, T. N. (Lebedev Inst. of Physics, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Cosmic ray variations in the stratosphere at various atmospheric pressures are investigated. The data obtained are used to determine the primary cosmic ray variation spectra, $\Delta T(p)/T(p)$ by the coupling coefficient method for particles of rigidity $p \geq 0.5$ GV for various solar activity periods. The variation spectrum has been chosen according to the Parker diffusion and convection model, in the form $\Delta T(p)/T(p) = 1 - \exp(-\psi)$ where $\psi = b/v(a + p)$ is the modulation parameter, a and b are the coefficients depending on solar activity level, v,p are the particle velocity and rigidity respectively. The values of $\psi(p)$ calculated for the half-yearly periods from 1959 to 1972 are presented. The value of the coefficient a is not variable over a long period (a = 1-2). For some periods (in 1961; 1962; July-December, 1971; Jan.-Dec., 1972; and during the solar minimum of 1965-1966), however, the variation spectrum became much more rigid. (auth)

19610 (CONF-730804-P2, pp 1317-1322) HYSTERESIS EFFECT IN COSMIC-RAY MODULATION. Vershell, H. J.; Mendell, R. B.; Korff, S. A. (New York Univ., NY). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The rigidity dependence of the modulation of cosmic ray protons and alphas at intermediate rigidities (2-13 Gv) during the declines and recoveries of the cosmic ray flux near cosmic ray minimum are examined. The observations of the NYU fast neutron detector at the high latitude transition maximum (principal response between 2 and 4 Gv) are combined with neutron monitor data between 1 and 13 Gv cutoff to estimate the time variation of the spectral index of the modulation parameter. The spectral index undergoes several excursions, all of which are consistent with earlier observations that the low rigidity protons and alphas lag the higher rigidities in Type I Forbush decreases particularly during the period from June 1969 to June 1971. (auth)

19611 (CONF-730804-P2, pp 1323-1328) SATELLITE MEASUREMENTS OF THE COSMIC-RAY ANISOTROPY AT 1 GV. Engel, A. R.; Dyer, C. S.; Quenby, J. J. (Imperial Coll. London). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Satellite quiet time anisotropy data obtained at altitudes greater than 20 earth radii from an integral detector with a 1 GV threshold during the period Dec. 1968 – April 1970 show an inward streaming component ~0.3% in amplitude and an azimuthal streaming from the east, varying from 0.6% amplitude at the start to <0.2% towards the end of the period. (auth)

19612 (CONF-730804-P2, pp 1329-1334) POSSIBLE EXPLANATION OF THE 0.3% SUNWARD STREAMING OF 1 GV COSMIC RAYS SEEN BY HEOS-1. Dyer, C. S.; Engel, A. R.; Quenby, J. J.; Webb, S. (Imperial Coll., London). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Possible causes of the 0.3% observed inward streaming of 1 GV galactic particles are discussed including sector structure effects, predictions of the spherically symmetric solution of the Fokker-Planck equation and off-ecliptic phenomena. (auth)

19613 (CONF-730804-P2, pp 1336-1339) RELATION OF THE RADIAL GRADIENT OF COSMIC-RAY PROTONS TO THE SIZE OF THE SOLAR-MODULATION REGION. Garrard, T. L.; Stone, E. C.; Vogt, R. E. (California Inst. of Tech., Pasadena). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The radial intensity-gradient of cosmic-ray protons has been calculated for a range of values of the distance to the boundary of a spherically symmetric solar-modulation region. It is found that the radial dependence of the gradients may be described in terms of two characteristic domains of the modulation region: (a) an "inner region" where the gradients are relatively small and constant, and (b) an "outer region" where the gradients are large and show a strong radial dependence. The magnitude of the gradient in the inner region is small for reasonable values for the physical parameters of the modulation mechanism. (auth)

19614 (CONF-730804-P2, pp 1343-1348) NUMERICAL STUDIES OF THE INTERACTION OF ENERGETIC PARTICLES WITH INTERPLANETARY-FIELD DISCONTINUITIES. Webb, S.; Quenby, J. J. (Imperial Coll., London). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Conventional transport theory representing the diffusion of energetic particles in interplanetary space concentrates on pitch angle scattering and the perturbation of a steady state distribution function. The effect of finite discontinuities in the field on individual particle trajectories is considered. The study applies to shocks, rotational discontinuities and situations where large amplitude, aperiodic Alfven waves are seen by the particles as field line directional discontinuities, either with or without change in $|B|$ values. It is thought that this approach may be especially useful in studying solar proton propagation at rigidities less than 1 GV. (auth)

19615 (CONF-730804-P2, pp 1662-1667) INTERPLANETARY QUIET-TIME DIFFERENTIAL SPECTRA OF PROTONS AND HELIUM BELOW APPROX. 2 MeV PER NUCLEON FROM PIONEER 10. Simpson, J. A.; Tuzzolino, A. J. (Univ. of Chicago). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Proton and helium spectra in the energy range 0.5 – 1.8 MeV nucleon^{-1} have been obtained from the University of Chicago Low-Energy Telescope on the Pioneer 10 spacecraft bound for Jupiter. These spectra, and spectra obtained simultaneously from an identical telescope on the Earth satellite IMP 7 at 1 a.u. may be represented by a power law $E^{-\gamma}$, with $\gamma = 2.9 \pm 0.4$ for both protons and helium nuclei, and yield a ratio of proton to helium abundances at 1 MeV nucleon^{-1} of 6.7 ± 2.0. Preliminary differential intensity gradients for protons and helium nuclei have been obtained. The measured gradients are (6 ± 6) percent per a.u. for both protons and helium nuclei over the radial range 1 to 3.6 a.u. (auth)

19616 (CONF-730804-P2, pp 1668-1673) ENERGY-DEPENDENT PHENOMENA OF MUONS AND NUCLEONS IN AUGUST 1972. Chasson, R. L. (Univ. of Denver). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

(1) The maximum primary rigidity of solar flare particles detected at earth on 7 August 1972 lay between 3 and 10 GV. (2) A daily wave with maximum at 1300 hours local time prevailed for particles of rigidity between 10 and 50 GV during the Forbush decrease recovery period 5-8 August 1972. (auth)

19617 (CONF-730804-P2, pp 1674-1679) COSMIC-RAY VARIATIONS IN THE ENERGY RANGE 1 TO 100 GeV DURING THE PERIOD OF AUGUST 2–8, 1972. Kuzmin, A. I.; Krymskii, G. F.; Altukhov, A. M.; Samsonov, I. S.; Skripin, G. V.; Chirkov, N. P.; Transkii, I. A. (Inst. of Cosmophysical Research and Aeronomy, Yakutsk, USSR). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The hourly values of cosmic ray currents in August 1972 are obtained and analyzed. The reasons for the observed extreme (up to 3000 km/sec) current values are discussed. The estimations of the regularity degree of the interplanetary magnetic field and its strength during the period are presented. (auth)

19618 (CONF-730804-P2, pp 1686-1689) AUGUST 1972 COSMIC-RAY STORM OBSERVED AT HIGH RIGIDITIES. Swinson, D. B. (Univ. of New Mexico, Albuquerque). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Observations of the August 1972 cosmic ray storm at three underground μ-meson telescopes are presented. The three telescopes are located in Bolivia (25 m.w.e.), Embudo Cave near Albuquerque, New Mexico (40 m.w.e.) and Socorro, New Mexico (80 m.w.e.). The threshold rigidities for these telescopes are 17, 30, and 52 GV, respectively. The total reduction in intensity for the Bolivia telescope is 4.4%, with about 3% reduction at Embudo, and about 1.5% reduction at Socorro. From these observations it is possible to assign an upper limiting rigidity of 60 to 65 GV to the cosmic rays affected by this storm. (auth)

19619 (CONF-730804-P2, pp 1690-1697) GENERALIZATION OF THE SPECTROGRAPHY METHOD USING POLAR COUPLING COEFFICIENTS AND THE ANALYSIS OF THE AUGUST 1972 EVENTS. Dorman, L. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow); Dvornikov, V. M.; Sergeev, A. V.; Shkhalokhov, G. Sh. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The spectrography method for distinguishing and studying the magnetospheric and interplanetary variations is generalized for observations of several secondary cosmic ray components at various altitudes. In this case the number of equations is greater than the number of the parameters determining the changes in the geomagnetic cut-off rigidity, ΔR_c and in the primary cosmic ray spectrum $\Delta D(R)/D$. A description is given of the solution of such a system by the method of maximum likelihood including experimental errors. As an example, the changes in ΔR_c and $\Delta D(R)/D$ in August, 1972 are studied on the basis of the data from the Irkutsk spectrograph (geomagnetic cut-off rigidity is 3.8 GV). (auth)

19620 (N-74-15475) ANOMALOUS ABUNDANCE OF COSMIC RAY NITROGEN AND OXYGEN NUCLEI AT LOW ENERGIES. McDonald, F. B.; Teegarden, B. J.; Trainor, J. H.; Webber, W. R. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Dec 1973. 15p. (NASA-TM-X-70566). NTIS $3.00.

Recent measurements using a cosmic-ray telescope on the Pioneer 10 spacecraft have revealed an anomalous spectrum of nitrogen and oxygen nuclei relative to other nuclei such as He and C, in the energy range 3 to 30 MeV/N. The intensity of nitrogen and oxygen nuclei is enhanced by a factor of up to 20 relative to their abundance in galactic or solar cosmic rays. (auth) (STAR)

19621 (N-74-16515) MEASUREMENT OF COSMIC RAY POSITRON AND NEGATRON SPECTRA BETWEEN 50 AND 800 MeV. Daugherty, J. K. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center) Jan 1974. 207p. (NASA-TM-X-70580). NTIS $12.50.

Thesis.

A balloon-borne magnetic spectrometer was used to measure the spectra of cosmic-ray positrons and negatrons at energies between 50 and 800 MeV. Comparisons of the separate positron and negatron spectra observed near the Earth with their expected intensities in interstellar space can be used to investigate the complex (and variable) interaction of galactic cosmic rays with the expanding solar wind. The present measurements, which have established finite values or upper limits for the positron and negatron spectra between 50 and 800 MeV, have confirmed earlier evidence for the existence of a dominant component of negatrons from primary sources in the Galaxy. The present results are shown to be consistent with the hypothesis that the positron component is in fact mainly attributable to collisions between cosmic-ray nuclei and the interstellar gas. The estimate of the absolute intensities confirms the indications from neutron monitors that in 1972 the interplanetary cosmic-ray intensities were already recovering toward their high levels observed in 1965. (auth) (STAR)

19622 BERYLLIUM-7 PRODUCTION FROM OXYGEN BY ATMOSPHERIC COSMIC RAYS. Nakamura, Y.; Mabuchi, H.; Hamaguchi, H. (Tokyo Univ.). Geochem. J. (Nagoya); 6: No. 2, 43-47(Dec 1972).

The production rates of ^{7}Be from ^{16}O by cosmic rays were measured at three locations of different latitudes and altitudes. From the altitude dependence of the production rates, the attenuation length of $L = 165 \pm 30$ g/cm^2 was obtained. This value falls in the range of the reported values obtained by physical methods for the atmospheric neutrons. The experimental value at sea level of the geomagnetic latitude, $\lambda = 25°N$, was in good agreement with the value calculated from the generally accepted atmospheric neutron spectrum and the best estimated excitation function. The latitude effect on the production rate is also discussed. (auth)

Stars

Refer also to abstracts 19898, 20046, 20073, 20226, and 20255.

19623 POSITIONAL CATALOGS OF STARS. I. Rybka, P. (Zaklad Astronomii, Wroclaw). Postepy Astron.; 22: No. 2, 81-89(Jun 1974). (In Polish).

In the first part of the review of positional catalogues of stars, the basic problems connected with these catalogues are described. After a short historical outline of the old catalogues the principles of modern catalogues as well as their errors are described. (auth)

19624 POSITIONAL CATALOGS OF STARS. II. Rybka, P. (Zaklad Astronomii, Wroclaw). Postepy Astron.; 22: No. 2, 91-107(Jun 1974). (In Polish).

A chronological description of fundamental cataloges is given. The interrelation between the catalogs and their characteristics are discussed. (auth)

19625 MODEL ATMOSPHERES OF LATE-TYPE STARS. Kipper, T. Publ. Tartu. Astrofiz. Observ.; 41: 63-100(1973).

Until now progress in computing model atmospheres of late-type stars is little compared with that of hotter stars. Main difficulties arise in treating the line blanketing due to molecular bands and the convection which carries significant amounts of flux in the atmospheric layers where the dissociation of molecules takes place. More complicated is the problem of finding the ratio of gas and electron pressures, because this is seriously affected by molecule formation. An attempt is made to compute model atmospheres for late-type stars in which the formation of molecules and the flux carried by convection have been taken into account. (auth)

19626 MOLECULAR ABSORPTION BANDS IN SPECTRA OF LATE-TYPE STARS. Kipper, T. Publ. Tartu. Astrofiz. Observ.; 41: 278-305(1973).

The intensities of molecular bands were computed using the model atmospheres of late-type stars and the results were compared with observations. (WDM)

19627 INELASTIC ELECTRON IMPACT TRANSITIONS AND THERMAL TRANSITION RATES FOR HYDROGEN. Kuusik, I.; Sapar, A. Publ. Tartu. Astrofiz. Observ.; 41: 306-321(1973).

An attempt is made to analyze in more detail the transition rates using properly defined arguments and approximation formulae for cross sections and reducing the arguments to a reasonable number for a numerical treatment. For electron impacts several approximations were worked out. Three different variants of approximations with different exactness and complexity are considered. (WDM)

19628 RELATIONS BETWEEN THE PARAMETERS OF THE DISTRIBUTIONS OF STELLAR ABSOLUTE AND APPARENT MAGNITUDES, PROPER MOTIONS, AND TAGENTIAL VELOCITIES. Iyeveer, M. Publ. Tartu. Astrofiz. Observ.; 41: 132-142(1973). (In Russian).

Relations are derived which enable us to estimate the parameters of the absolute magnitude distribution through the distribution moments of the kinematical quantity x. The mean value M_0 and the dispersion σ_{M0} for the absolute magnitudes per unit volume may be estimated. Similar relations for the parameters M and σ_M of absolute magnitudes sampled according to the apparent magnitudes are expressed. These relations are exact in the following assumptions: (a) space density of stars D_0 is constant, (b) frequency distribution of tangential velocities $\psi_0(t)$ does not depend upon M and the distance, (c) frequency distributions of absolute magnitudes $\varphi_0(M)$ and $\varphi(M)$ are represented by the normal distribution with parameters independent of distance. The influence of the deviations of φ from the normal distribution upon the relations is analyzed. It is shown how to improve the estimates of M and σ_M in case of large deviations of $\varphi(M)$ from the normal distribution. (auth)

19629 SPECTROPHOTOMETRY OF FIVE K- AND M-STARS. Kipper, M.; Khyanni, L. Publ. Tartu. Astrofiz. Observ.; 41: 143-164(1973). (In Russian).

The curve-of-growth technique was used to find atmospheric parameters and abundances of elements in the atmospheres of γ Sge (K5III), α Vul (MOIII), β Peg (M2II-III), 61 Cyg A (K5V), and 61 Cyg B (K7V). The relative abundances are compared with those of the Sun. The abundances are nearly the same as in the Sun, except Cr and Sc. (auth)

19630 PHOTOELECTRIC OBSERVATIONS OF THE ECLIPSING VARIABLE DO CAS IN 1970 TO 1971. Pustyl'nik, I.; Malyuto, V. Publ. Tartu. Astrofiz. Observ.; 41: 165-190(1973). (In Russian).

In 1970–1971 photoelectric observations of the close binary star DO Cas in B, V colors were carried out with the aid of a photometer attached to the 20" Cassegrain reflector of Tartu Astrophysical Observatory. 473 and 475 single observations in B and V correspondingly were secured during 21 nights. BD +59°533 served as a comparison star and BD +59°513 as a check star. An epoch of minimum of light determined by Hertzsprung's method is J. D. 2441035.3454 ± 0.0005. The value of the period, as computed from this epoch and that of Winkler is P = $0^d.68466671$. (WDM)

19631 PROBLEMS OF DYNAMICS AND EVOLUTION OF STELLAR SYSTEMS. Kuzmin, G. G. Publ. Tartu. Astrofiz. Observ.; 40: 3-10(1972). (In Russian).

The speech held in connection with the awarding of the Bredikhin gift is presented. The main results of the author on the theory of the third integral of motion, on the models of spherical and axial symmetric self-gravitating stellar systems, and on the theory of irregular gravitational forces are reviewed. (auth)

19632 COLORIMETRY OF CH CYGNI. Luud, L. Publ. Tartu. Astrofiz. Observ.; 40: 163-166(1972).

Several authors have reported unusual light variations and spectral peculiarities in CH Cygni. An attempt is made to check whether the variations in colors are in agreement with the symbiotic model. (WDM)

19633 THERMODYNAMIC QUANTITIES FOR M-TYPE STELLAR ATMOSPHERES. Kipper, M.; Kipper, T. Publ. Tartu. Astrofiz. Observ.; 40: 167-180(1972). (In Russian).

Computations of the specific heats c_p and c_v, the ionization factor Q, the adiabatic gradient ∇_{ad} and the adiabatic sound velocity u, were carried out for conditions of M-type stellar atmospheres. (auth)

19634 INFLUENCE OF METAL CONTENT ON THE NARROW-BAND MEASUREMENTS IN THE SPECTRA OF THE SOLAR TYPE STARS. Malyuto, V. D. Publ. Tartu. Astrofiz. Observ.; 40: 181-200(1972). (In Russian).

A method, arising from an improvement of the Conti–Deutsch method, is proposed for calculating the dependences of narrow-band indices in the spectra of the solar-type stars on their metal content. It is shown that the agreement of calculated values with observations is somewhat better than with the former. The calculated values of the index δ agree with observations at least for a moderate metal deficit. It has been shown that the index for the H_δ line can serve as an efficient criterion for the effective temperature in the F and early G dwarfs of various chemical composition. (auth)

19635 NEW FLUX ITERATION ALGORITHMS FOR MODEL STELLAR ATMOSPHERES. Sapar, A. Publ. Tartu. Astrofiz. Observ.; 40: 259-272(1972).

Topics covered include the source function, the source function variation expressed by flux, equations for flux iteration, the source function variation for angular quadrature, the Lucy method with pressure correction, and the Avrett-Krook method with pressure correction. (WDM)

19636 DENSITY PROJECTIONS AND GENERALIZED ISOCHRONIC MODELS OF SPHERICAL STELLAR SYSTEMS. Kuzmin, G. G.; Veltmann, Yu. I. K. Publ. Tartu. Astrofiz. Observ.; 40: 281-323(1972). (In Russian).

The relations between the space density, or the potential, and the projections of space density together with some related functions, especially the slit density, were studied. Concrete examples are provided for the generalized isochronic models, which include, as special cases, the Schuster model and the isochronic model. (WDM)

19637 CHEMICAL COMPOSITION OF WOLF–RAYET STAR ENVELOPES. Nugis, T. Publ. Tartu. Astrofiz. Observ.; 40: 325-340(1972).

The chemical compositions of the following stars are discussed: HD 191765 (WN6), HD 192163 (WN6), and HD 192103 (WC7). Equivalent widths of emission lines from Hugie, et. al. (1971) and Smith, et. al. (1970) were used. (WDM)

19638 TEMPERATURES OF WOLF–RAYET STARS. Nugis, T. Publ. Tartu. Astrofiz. Observ.; 40: 341-354(1972). (In Russian).

It is assumed that radiation from Wolf–Rayet stars consists of the black-body radiation of a hot "core" and of the diffuse radiation of an envelope. The observed dependence of T_c on λ is explained and "core" temperatures are determined. (auth)

19639 STUDY OF THE EMISSION SPECTRA OF WOLF–RAYET COMPONENTS OF THE DOUBLE SYSTEMS HD 193 077 AND HD 192641. Nugis, T. Publ. Tartu. Astrofiz. Observ.; 40: 355-363(1972). (In Russian).

By the study of the emission lines of the Wolf–Rayet components of the binaries HD 193077 and HD 192641 it was established that T_e (temperature of free electrons) is nearly 80,000° for the star WN 5 and ≈50,000° for the star WC 6-7. Minimum values of T_e are given and relative abundances of the chemical elements determined are presented. (auth)

19640 PULSATING STARS. Cox, J. P. (Colorado Univ., Boulder). Rep. Progr. Phys.; 37: No. 5, 563-698(1974).

Pulsating stars are a subset of the class of intrinsic variable stars. In this review the main emphasis is on purely radial pulsations of spherically symmetric, nonrotating, nonmagnetic stars. Most of the problems in this area can be treated on the basis of Newtonian mechanics and gravitation. However, some modifications introduced by general relativity are described. After a short review of the relevant stellar time scales, the main observational data on pulsating stars are summarized, and some elements of the basic theory of pulsating stars presented. Considerable emphasis is given to the linear theory of radial pulsations, but nonlinear pulsation calculations are also reviewed. An attempt is made to assess present understanding of the causes and nature of pulsations in the various known types of pulsating stars and some important unsolved problems are summarized and discussed. One of the most important of these is the interaction between thermal convection and pulsations in stars. Applications of pulsation theory to miscellaneous kinds of objects not ordinarily thought of as pulsating stars are discussed. This includes stars in "quasi-hydrostatic" equilibrium, relativistic pulsation theory, white dwarfs, neutron stars, rotating stars, magnetic stars, and oscillating models of the Universe. (auth)

19641 URANIUM IN HR8911. Galeotti, P.; Lovera, E. (Conseglio Nazionale delle Richerche, Turin). Nature (London); 249: No. 5453, 130-131(10 May 1974).

Some observations are reported on the spectrum of the Cr–Eu–Sr peculiar star HR 8911 showing evidence for the presence of r-process elements. The pressure of Os and U was confirmed. There was also some evidence for the presence of Pt in the atmosphere of this star. It is concluded that HR 8911 should be added to the list of Ap stars in which r-process elements have been detected. The hypothesis of a supernova explosion of a nearby star is stated to be an acceptable theory, since the nucleosynthesis of r-process elements requires a very high neutron density, such as that found in the interior of a highly evolved star. Magnetic accretion could also play an important role. (UK)

19642 POSSIBILITY OF FLARES OF WHITE DWARFS. Gurzadyan, G. A. (Byurakan Astrophysical Observatory, Moscow). Astrophysics (Engl. Transl.); 8: No. 3, 284-286(1972).

Translated from Astrofizika; 8: No. 3, 479-483(1972).

Warner et al. (1970) have published a note in Nature reporting an observation of a flare of a blue variable–G 44-32–which is included in the list of white dwarfs. The increase in the brightness during the time of this flare (Feb. 7, 1970) was 0.61m in B light. Judging from the light curve, the duration of the flare was of the order of one minute. The light curve itself has the profile typical for a flare of cold white dwarfs. (WDM)

19643 PULSATIONS AND STABILITY OF OBLATE ROTATING WHITE DWARFS. Vartanyan, Yu. L. (Erevan State Univ.). Astrophysics (Engl. Transl.); 8: No. 3, 244-247(1972).

Translated from Astrofizika; 8: No. 3, 413-418(1972).

The energy method is used to investigate the effect of oblateness on the equilibrium and stability parameters of rigidly rotating white dwarfs. It is shown that for such configurations the oblateness effect is more important for the energy of rotations than for the gravitational energy, and this leads at one and the same central density to a slight decrease in the mass and increase in the period of pulsation compared with spherically symmetric configurations. (auth)

19644 STABILITY OF ROTATING BARYON STARS. Arutyunyan, G. G.; Sedrakyan, D. M. (Erevan State Univ.). Astrophysics (Engl. Transl.); 8: No. 3, 248-250(1972).

Translated from Astrofizika; 8: No. 3, 419-423(1972).

The results are given of a calculation (in the framework of general relativity) of quasiradial pulsations of rotating baryon stars. It is shown that to within the accuracy of the calculations the central densities of rotating and static configurations that are critical in the sense of loss of stability are equal. (auth)

19645 ANALYTIC EXPRESSIONS FOR THE PARAMETERS OF ROTATING STARS. Guseinov, O. Kh.; Kasumov, F. K. (Shemakha Astrophysical Observatory, USSR). Astrophysics (Engl. Transl.); 8: No. 3, 251-255(1972).

Translated from Astrofizika; 8: No. 3, 425-432(1972).

Analytic expressions for the parameters of rotating stars were obtained in a special case of a pseudopolytrope (power law). A one-to-one relationship between polytropes and such pseudopolytropes in the most important energy parameters was established. (auth)

19646 STABILITY OF A ROTATING INHOMOGENEOUS STAR. Vandakurov, Yu. V. (Ioffe Inst. of Physics and Tech., Moscow). Astrophysics (Engl. Transl.); 8: No. 3, 256-259(1972).

Translated from Astrofizika; 8: No. 3, 433-439(1972).

A study is made of the stability against arbitrary small-scale perturbations of the radiative equilibrium zone of a rigidly rotating star with inhomogeneous composition. For stability of nonaxisymmetric perturbations it is necessary that the surfaces of constant molecular weight coincide with the isobaric (or isothermal) surfaces. Instability can also be suppressed if there is a comparatively weak toroidal magnetic field. (auth)

19647 EVOLUTION OF A WHITE DWARF THAT ACCRETES HYDROGEN-RICH MATTER. Redkoborodyi, Yu. N. (Principal Astronomical Observatory, Moscow). Astrophysics (Engl. Transl.); 8: No. 3, 233-238(1972).

Translated from Astrofizika; 8: No. 3, 393-403(1972).

A study was made of the possible consequences of a thermal explosion in the hydrogen shell of a white dwarf. It is shown that the change in the temperature of a layer energy source with the time can be investigated by means of simple arguments based on the energy balance in the hydrogen-burning layer. Such an approach enables one to elucidate the role of the screening effect in the development of a hydrogen flare and also to conclude that the attainment of a thermally stable state is very improbable. In the framework of the same approximation it is shown that in the ordinary quasistatic approach to the evolution of a white dwarf with growing hydrogen shell the "ignition point" of the reaction $3^4He \rightarrow {}^{12}C$ is apparently fundamentally unattainable. (auth)

19648 QUASIRADIAL PULSATIONS OF ROTATING RELATIVISTIC POLYTROPES. Papoyan, V. V.; Sedrakyan, D. M.; Chubaryan, E. V. (Erevan State Univ.). Astrophysics (Engl. Transl.); 8: No. 3, 239-243(1972).

Translated from Astrofizika; 8: No. 3, 405-412(1972).

The frequencies of quasiradial pulsations are found for rotating relativistic polytropes with n = 1.5, 2, 2.5, and 3 and also the values of the relativity parameter α that are critical in the sense of loss of stability. It is shown that for a polytrope n = 3 rotating with the greatest possible angular velocity without loss of matter the stability is lost for $r_0 \leq 140 r_g$. (auth)

19649 EXPLOSIONS OF NOVAE IN CLOSE BINARY SYSTEMS. Tutukov, A. V.; Yungel'son, L. R. (Astronomical Council, Moscow). Astrophysics (Engl. Transl.); 8: No. 3, 227-229(1972).

Translated from Astrofizika; 8: No. 3, 381-386(1972).

Under the assumption that the activity of novae is due to a white dwarf in a closed binary system accreting matter from the second component, estimates are made of the time intervals between explosions, the energy generated in explosions, and the mass of the ejected shells. (auth)

19650 RADIAL PULSATIONS OF A WHITE DWARF IN THE CASE OF INHOMOGENEOUS ROTATION. Basko, M. M.; Imshennik, V. S. (Inst. of Applied Mathematics, Moscow). Astrophysics (Engl. Transl.); 8: No. 3, 230-232(1972).

Translated from Astrofizika; 8: No. 3, 387-391(1972).

The energy method is used to estimate the periods of radial pulsations of inhomogeneously rotating white dwarfs near the Chandrasekhar limit. It is shown that allowance for neutronization effects appreciably increases the period of radial pulsations, but nevertheless the pulsations periods of rotating stars may be shorter than those of nonrotating stars by a factor of 4 to 5. (auth)

19651 FORM OF NOVA SHELLS. Gorbatskii, V. G. (Leningrad State University). Astrophysics (Engl. Transl.); 8: No. 3, 220-226(1972).

Translated from Astrofizika; 8: No. 3, 369-380(1972).

Numerous observational data indicate that there is a continuous loss of mass by close double systems consisting of dwarfs, in particular, by novae and recurrent novae. As a result of the escape of matter, a circumstellar envelope is formed with matter concentrated near the orbital plane. The principal shell of a nova ejected in an outburst must interact with the circumstellar envelope. Because the matter near the orbital plane is slowed down, the original form of the principal shell changes. A certain time after the outburst the visible shell must be extended in the direction at right angles to the orbital plane. The form of the shell is calculated as a function of the time. The mass of the shell of DQ Her is estimated on this basis from its observed extension. (auth)

19652 SCATTERING OF RESONANCE RADIATION IN A SPHERE. Nagirner, D. I. (Leningrad State University). Astrophysics (Engl. Transl.); 8: No. 3, 210-219(1972).

Translated from Astrofizika; 8: No. 3, 353-368(1972).

A study was made of the scattering of radiation in a resonance line in a homogeneous sphere with spherically symmetric radiation sources. An investigation was made of the resolvent of the integral equation of the problem and the number of photon scatterings. For the case of pure scattering and an optically thick sphere, the asymptotic behavior of the resolvent, the mean number, and the variance of the number of scatterings of a photon were found. An asymptotic formula was also obtained for the intensity of the emerging radiation when there is a uniform distribution of the sources. The results may be of interest for the physics of planetary nebulae. (auth)

19653 OBSERVATIONS OF CIRCULAR POLARIZATION IN WHITE DWARFS AND THE NUCLEI OF PLANETARY NEBULAE. Shulov, O. S.; Belokon, E. T. (Leningrad State Univ.). Astrophysics (Engl. Transl.); 8: No. 3, 205-209(1972).

Translated from Astrofizika; 8: No. 3, 343-352(1972).

The results are given of observations of circular polarization of 10 white dwarfs and five nuclei of planetary nebulae. Variable circular polarization was found for two white dwarfs of the spectral type DA: Ox + 25°6725 and L1244-26, the polarization of the former varying periodically with period 0.1493d. The polarization of GW + 70°8247 was also found to be variable. Within the limits of the errors of observation, no polarization was found in the nuclei of the planetary nebulae. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

19654 (N-73-32731) MAGNETOSPHERIC STRUCTURE OF PULSARS. Roberts, D. H. (Stanford Univ., Calif. (USA). Inst. for Space Research). Aug 1973. 127p. (NASA-CR-135587; SUIPR-537). NTIS $6.50.

A model of pulsar magnetospheres is described which has evolved inductively from the work of Sturrock, where the radiation is produced near the surface of a neutron star. Some of the theoretical ideas of others, particularly those of Sturrock, are discussed. The braking index n and period–pulse-width distribution of pulsars are first reinvestigated by relaxing the conventional assumption that $R_Y = R_L$, where R_Y is the radius of the neutral points marking the transition from closed to open magnetic field lines, and R_L is the radius of the light cylinder. This is replaced by the parameterization $R_Y = R_* (1 - \eta)$ power R_L (η), where R_* is the neutron star radius. If the radiofrequency radiation is created near the surface and beamed along open field lines, it is found that a good fit to the period–pulse-width distribution can be obtained for η in the range $0.5 \leq \eta \leq 0.7$. The relation $n = 1 + 2\eta$ then gives $n = 2.2 \pm 0.2$, which is in good agreement with the values measured for the Crab pulsar. (auth) (STAR)

19655 (N-74-15489) STUDY OF OPTICAL PROPERTIES OF X-RAY SOURCES. Final Report, 1 July 1972–30 June 1973. VandenBout, P. A. (Texas Univ., Austin (USA)). 30 Jun 1973. 5p. (NASA-CR-136551). NTIS $3.00.

A report is presented of R and D of the optical properties of x-ray sources. The topics discussed include: (1) simultaneous optical and x-ray observations; (2) coronal line search in Cygnus Loop; (3) Her X-1 = HZ Her observations; (4) Cyg X-1 observations; and (5) Sco X-1 radio companion observations. (STAR)

19656 STARQUAKES. Pines, D. (Illinois Univ., Urbana). New Sci.; 62: No. 900, 543, 547(30 May 1974).

Erratic timekeeping by some pulsars implied that they are periodically racked by internal convulsions. The restless behavior of the Crab pulsar is considered to be due to "starquakes" which take place in the outer solid crust of the star. The stellar crust is unusually stable but it is subject to enormous gravitation-induced stresses as the star slows down. When these stresses exceed the yield point of the crustal material, the crust will crack—a starquake. A second type of "quake" in the stellar crust is brought about by angular strains induced by internal magnetic torques, or external radiation torques, perpendicular to the stellar axis of rotation. The large frequency jumps which have been observed for the Vela pulsar are suggested to be due to corequakes which represent the sudden release of elastic energy stored in a solid neutron lattice deep in the stellar interior. The wobble

observed in Herculis X-1 is considered and a possible explanation given. To conclude it is pointed out that there is a possible terrestrial application of these observations on neutron stars, the fact that the Chandler wobble and earthquakes may have a common excitation source—the release of elastic energy stored in the Earth. (UK)

19657 PLASMA THEORY OF SCORPIUS X-1. Magnetohydrodynamic and Optical Analyses. Ichimaru, S. (Tokyo Univ.); Nakano, T. Progr. Theor. Phys. (Kyoto); No. 6, 1867-1878(Dec 1973).

A theoretical model of Sco X-1 phenomena is developed, based on the idea of a magnetic white dwarf undergoing accretion. A magnetohydrodynamic analysis of the accreting plasma flow predicts a formation of shock-like structure at a distance $\bar{R}-R$ from the stellar surface, where R is the stellar radius; inside the shock front, the plasma is heated through excitation of plasma turbulence, and thereby emits copious electromagnetic radiation mostly in the x-ray domain. An optical analysis of the accreting plasma is carried out with emphasis on its luminosity and optical depth. The total luminosity of 10^{37} erg/sec and the cutoff frequency around 2.25 eV can be fitted with such magnetohydrodynamic and optical analyses by the choice of the parameters, for example: $R = 2 \times 10^8$ cm, $M = M_\odot$, $\bar{R} - R = 7.4 \times 10^4$ cm, plasma density in the radiation domain = 4.8×10^{18} cm^{-3}, and the surface magnetic field = 1.8×10^6 gauss. The origin of the superthermal hard x rays is accounted for in terms of the stochastic acceleration of electrons in the turbulent plasma. A possible mechanism of radio flaring is also suggested. (auth)

19658 PECULIARITIES OF QUASAR REDSHIFTS AND HYPOTHESES TO EXPLAIN THEM. Kipper, A. Publ. Tartu. Astrofiz. Observ.: 40: 11-51(1972).

A hypothesis is presented according to which the redshift of the spectral lines of distant cosmic objects is interpreted as a continuous flow of the energy of photons into the cosmological vacuum. The decrease of energy is accompanied by a decrease in frequency. The quantum theory of electromagnetic waves based on this hypothesis enables one to explain why 1) the values of the absorption-line redshifts of several quasars are not unique, 2) the values of z derived from the absorption lines accumulate around the quantity z = 1.95, 3) there are only a few cosmic objects with the redshift z > 2, 4) the correlation between radio brightness and the z value is very slight or missing altogether, especially in the case of quasars with faint radio brightness. (auth)

19659 THEORY OF THE REDSHIFT OF THE SPECTRAL LINES OF COSMOLOGICAL OBJECTS. Kipper, A. Publ. Tartu. Astrofiz. Observ.; 40: 73-105(1972).

To interpret the peculiarities of the redshifts of the spectral lines of light coming from distant cosmic objects, the author in a previous report put forward a hypothesis according to which cosmological space conducts electricity and thus is able to absorb electromagnetic radiation which passes through it. In the present report the author gives this theory a deeper theoretical motivation, developing the quantum theory of electromagnetic radiation in the absorbing medium, i.e. cosmological vacuum. (auth)

19660 REGULARITIES IN THE REDSHIFTS OF QUASAR SPECTRAL LINES. Kipper, A. Publ. Tartu. Astrofiz. Observ.; 41: 253-269(1973).

The absorption spectra of five quasars, namely 4C 05.34, PHL 957, PKS 0237-23, TON 1530, and 3C 191, were studied with the aim of discovering regularities in the multiplicity of the value of the redshift z obtained from measurements of absorption lines. It was established that the discrete values of the redshift z of a given cosmological object can be calculated by a certain formula and that observational data fit this formula well. At the same time, an explanation is given why the number of lines in the absorption spectra of quasars grows with the increases of the redshift. The fit between the theory and observational data is demonstrated by four tables. (auth)

19661 ANOMALOUS REDSHIFT OF 21 CENTIMETER RADIATION PASSING NEAR THE SUN. Kipper, A. Publ. Tartu. Astrofiz. Observ.; 41: 3-19(1973).

The magnitude of the redshift of 21 cm radio waves (Tau A) is calculated for the case when they penetrate the solar corona. The magnitude, 10^{-7} to 10^{-10}, is in reasonable agreement with observations. (WDM)

19662 AUTOMATIC PROCESSING OF OBSERVATIONS OF LINEAR POLARIZATION OF DISPERSED RADIOWAVES. Chekalev, S. P.; Mel'nikov, A. A.; Pososhenko, L. Z.; Khrulev, V. V.; Shmulovich, S. A. Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 12, 1889-1892(1973). (In Russian).

A block diagram of an apparatus for processing of the subject polarization data is shown. The machine output is in the form of tables and graphs. Use of the system to study 1250-megahertz cosmic radiowaves showed that this shorter method has a 5 to 8% greater precision than manual processing methods. (TTT)

19663 EFFECT OF FARADAY ROTATION ON MEASUREMENT OF VISIBILITY FUNCTION OF COSMIC RADIO SOURCES. Vinyaikin, E. N. Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 12, 1800-1803(1973). (In Russian).

By a mathematical development, the factor describing the subject effect is shown to consist of two components. One component describes the rotation on a central frequency; the other is related to dispersion of the Faraday rotation. Formulas are given for the case where one antenna has a linear polarization and the other a circular and for the case where both have a circular polarization, the latter being the most favorable for interferometric measurements with strong and nonhomogeneous Faraday rotation of the plane of polarization of radiowaves. (TTT)

19664 TEMPERATURE GRADIENT IN HII FIELDS. Pyatunina, T. B. (Leningrad Branch of Special Astrophysical Observatory). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 12, 1804-1810(1973). (In Russian).

The temperature gradient in several zones of ionized hydrogen and its effect on the radiowave continuum and on the radiation in the recombination lines were evaluated using published data on the Orion A and Omega nebulae. Plots are given showing the temperatures at the centers of the nebulae and the gradients, the observed and calculated electron temperature spectra, and the recombination radiation in the α lines. (TTT)

19665 LIMITING SENSITIVITY OF RADIOTELESCOPES IN STUDYING HETEROGENEITY OF DISPERSED RADIATION. Kislyakov, A. G.; Shvetsov, A. A. Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 12, 1846-1852(1973). (In Russian).

The sensitivity of a radiotelescope with an ideal collector is considered mathematically for several individual cases when the background of the radiation is thermal. (TTT)

19666 METHODS AND APPARATUS FOR OBSERVING PULSARS IN THE DECAMETER WAVELENGTH RANGE. Bruk, Yu. M.; Ustimenko, B. Yu. Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 12, 1867-1870(1973). (In Russian).

The subject apparatus consists of 256 cumulative condensers with electronic switches. In operation, the signal may be broken down into either 16 or 256 elements. By selection of the frequency of adjustment of the collectors, the displacement of the pulsar pulses at different frequencies due to dispersion in interstellar space can be compensated. A typical recording made with the apparatus is shown. (TTT)

19667 FARADAY DEPOLARIZATION OF INTEGRAL RADIOWAVES FROM A DISCRETE SOURCE. Tokarev, Yu. V. Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 12, 1789-1795(1973). (In Russian).

The peculiarities of Faraday depolarization of the subject waves were analyzed mathematically for the case when the magnetoactive plasma responsible for the depolarization is concentrated in a dense cloud, without sharp boundaries, occupying a small fraction of the source volume. Equations are derived for both a homogeneous and a nonhomogeneous magnetic field, and theoretical data are compared graphically with experimental for several discrete sources. Such a comparison for the crab Nebula, which has a shell of dense condensation of ionized hydrogen (the so-called "filaments"), shows good agreement of calculated and observed values. (TTT)

19668 THE MOTION OF BLACK HOLES. Gibbons, G. W. (Cambridge Univ. (UK). Dept. of Applied Mathematics and Theoretical Physics). Commun. Math. Phys.; 35: No. 1, 13-23(Jan 1974).

2 figs.; 15 refs.

The motion of axisymmetric, nonrotating black holes is discussed using the properties of Weyl solutions. It is shown that there are no such solutions representing more than one black hole or black holes and ordinary massive bodies apart from the exceptional case of a massive body which surrounds or partially surrounds a black hole. A new exact solution is obtained representing a black hole chased by a negative mass particle, both objects being uniformly accelerated and all solutions representing a single black hole tidally distorted by an external static, axisymmetric gravitational field are obtained. (auth)

19669 ENERGY IN ROTATING NEUTRON STARS. Avakyan, R. M.; Arutyunyan, G. G.; Saakyan, G. S. (Erevan State Univ.). Astrophysics (Engl. Transl.); 8: No. 3, 282-283(1972).

Translated from Astrofizika; 8: No. 3, 476-479(1972).

An energy source that could ensure the luminosity of a pulsar—the additional gravitational energy due to the deformation of rotating stars—is considered. (WDM)

19670 RADIATION SPECTRUM OF A SOURCE MOVING IN A STABLE CIRCULAR ORBIT NEAR A ROTATING BLACK HOLE. Polnarev, A. G. (Physical-Technical Inst., Moscow). Astrophysics (Engl. Transl.); 8: No. 3, 273-279(1972).

Translated from Astrofizika; 8: No. 3, 461-471(1972).

A study is made of a source of electromagnetic radiation that moves in a stable circular orbit in the equatorial plane of a rotating black hole. The spectral profile, averaged over a period of the orbital motion, detected by a distant observer is found for the case when the radiation is almost monochromatic in the self-frame of reference of the source. (auth)

19671 RELATIVISTIC TURBULENT PLASMA IN PULSARS. Tsytovich, V. N.; Kaplan, S. A. (Lebedev Inst. of Physics, Moscow). Astrophysics (Engl. Transl.); 8: No. 3, 260-272(1972).

Translated from Astrofizika; 8: No. 3, 441-460(1972).

Near pulsars an ultrarelativistic plasma is in a strong magnetic field. Then the unavoidable synchrotron losses of the transverse energy of the particles draw out the particle distribution function along the magnetic lines of force. In the paper the dispersive properties of such a plasma are studied. The branches of oscillations and waves are found, and it is shown that waves of Alfvén type are unstable. This instability is of kinetic type ($\gamma\alpha \ll \omega$) and is universal in the sense that all distribution functions that decrease with increasing energy are unstable. Therefore, the plasma in the neighborhood of a pulsar is always turbulent and generates intensive radiation that propagates preferentially along the magnetic lines of force. (auth)

Solar Phenomena

Refer also to abstracts 18445, 19589, 19590, and 19614–19616.

19672 (CONF-730804-P2, pp 1088-1093) MAGNETOSPHERIC WINDOWS FOR ACCESS OF SOLAR PROTONS TO AURORAL PEAKS. Gall, R.; Bravo, S. (Univ. Nacional Autonoma de Mexico, Mexico City). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The major role played by the neutral and plasma sheets in the access of protons into the geomagnetic cavity and in the illumination of low latitudes of polar caps during the anisotropic phase of solar proton events, is analyzed. Detailed study on the windows along the plasma and neutral sheets for penetration of 5-300 MeV protons arriving to auroral regions is performed. The location, the width of the windows and their dependence on the pitch angle distribution of the anisotropic flux is studied with the help of different magnetospheric models by means of numerical integration of trajectories. A general discussion about the recent models of the uneven illumination is performed. (auth)

19673 (CONF-730804-P2, pp 1095-1100) CHARGED-PARTICLE ACCESS CALCULATIONS. Masley, A. J.; Olson, W. P.; Pfitzer, K. A. (McDonnell Douglas Astronautics Co., Huntington Beach, CA). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Particle trajectories were calculated in Olson's (1972) distributed current model of the magnetosphere in order to identify the source region for particles which reach specific locations in the polar cap. This was done for 5, 20 and 70 MeV protons for a series of latitudes on the noon-midnight meridian and the dawn-dusk meridian. The source region for the low latitude drift around region, which defines the cutoffs, is the dawn sector of the magnetosphere and not the neutral sheet of the tail. The cutoffs determined are significantly lower than previous calculations and agree to within 1 to 3° with measured values. (auth)

19674 (CONF-730804-P2, pp 1108-1115) ANALYTICAL SOLUTION TO THE DIRECT AND INVERSE PROBLEMS FOR THE SOLAR COSMIC-RAY EFFECT ON LOWER IONOSPHERE. Dorman, I. V.; Dorman, L. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Analytical methods for solving the direct (determination of ionization rate in the lower ionosphere as a function of altitudes on the basis of present composition and spectrum of solar cosmic rays) and inverse (determination of solar cosmic ray spectrum and geomagnetic cut-off rigidity on the basis of ionospheric data) problems of solar cosmic ray effects on the ionosphere have been developed. (auth)

19675 (CONF-730804-P2, pp 1178-1183) CHARACTERISTICS OF ASCENDING SOLAR PROMINENCES. Tandberg-Hanssen, E.; Hansen, R. T. (National Center for Atmospheric Research, Boulder, CO). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

New coronagraph observations of ascending prominences are reported, and general characteristics of such objects are reviewed. Several of the prominences studied are of particular interest because of their association with solar flares and Type II and IV radio bursts. Estimates are given of the mass and energy introduced into the interplanetary medium by the prominences. (auth)

19676 (CONF-730804-P2, pp 1184-1189) SOLAR CYCLE VARIATIONS IN THE WHITE-LIGHT CORONA. Eddy, J. A.; Hansen, R. T. (National Center for Atmospheric Research, Boulder, CO). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Observations of the white light ("K") corona are described. It is suggested that it be considered as an index for the study of solar modulation of galactic cosmic rays. (auth)

19677 (CONF-730804-P2, pp 1349-1354) STATIONARY SOLUTIONS OF THE TRANSPORT EQUATION FOR A SOURCE OF SOLAR PARTICLES. Beuermann, K. P.; Richter, A. K.; Wibberenz, G. (Institut fuer Reine und Angewandte Kernphysik, Kiel). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The spherically symmetric, stationary cosmic-ray transport equation, including the effects of diffusion, convection, and adiabatic deceleration, is solved numerically for a steady source of solar particles. A functional dependence of the energy-independent diffusion coefficient $K(r) = K_1 r^b + K_2 r^c$, employing realistic combinations of K_1, K_2, b, and c is assumed. These calculations, together with measurements of the radial gradient and anisotropy of corotating stationary events, may be used to gain information on the local values of K and dK/dr. Considering protons of ~1 MeV, it is found that diffusive effects are always important at certain radii and that the radial distributions of the particle densities differ appreciably from those obtained from the purely convective solution. (auth)

19678 (CONF-730804-P2, pp 1355-1360) TRANSPORT OF SOLAR PARTICLES INTO INTERPLANETARY SPACE. Martinic, N. J.; Cecchini, S. (Chacaltaya Cosmic Ray Lab., La Paz, Bolivia). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The numerical solution of the spherical, steady state, Fokker-Planck equation of transport in a system of reference anchored at the earth with the energy variable T, as measured in a frame moving with the solar wind, shows a good fitting to recorded data in the interplanetary space during 1965-1968. The boundary conditions at the solar surface consider the energy transformation from the fixed frame into the moving one. Densities and gradients in an energy range (~6 orders of magnitude, centered around 1 GeV/nucleon) and radial distances (up to 5 a.u.) are illustrated in stereographic projections. In the computations the diffusion coefficient is given by $k_{rr} = k(r,R)$, and the density, u, smooth, i.e. $\epsilon = (v/w)\,|(T/u)\,\partial u/\partial T| \ll 1$, where w is the particles' speed and v is the solar wind velocity. The radial anisotropies are also presented. (auth)

19679 (CONF-730804-P2, pp 1361-1366) COHERENT PROPAGATION OF CHARGED PARTICLE BUNCHES IN RANDOM MAGNETIC FIELDS. Earl, J. A. (Univ. of Maryland, College Park). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

When the distribution function for energetic particles moving in interplanetary space is expressed in terms of eigenfunctions of an operator which describes pitch angle scattering by random magnetic fields, the familiar phenomenon of diffusion is the domi-

nant solution of the transport equations provided that the spectrum of magnetic fluctuations is not too steep. However, if this condition is not satisfied, the dominant solution of the same equations is a new mode of transport in which density inhomogeneities propagate coherently along the guiding field with a characteristic velocity equal to half the particle speed. The most striking manifestation of this phenomenon is the observed "scatter free" propagation of solar flare electrons below 1 MeV. (auth)

19680 (CONF-730804-P2, pp 1367-1371) INFLUENCE OF CORONAL MAGNETIC STRUCTURES ON LOW-ENERGY SOLAR PROTON EVENTS. Gold, R. E. (Univ. of New Hampshire, Durham); Nolte, J. T.; Roelof, E. C.; Reinhard, R. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The systematic analysis of interplanetary particle, plasma and magnetic field observations is undertaken, and the results are related to the structure of the corona during Carrington rotations 1521-7 (May-Nov. 1967). The coronal connection longitude is estimated and the "injection profiles" compared with neutral line structure from H_α synoptic charts. It is found that polarity cells repeatedly act as release sites on successive rotations. Although the particle acceleration is usually identified with an active region, that region is often not contained in the polarity cell from which particles are injected into the interplanetary medium. (auth)

19681 (CONF-730804-P2, pp 1372-1377) CORONAL TRANSPORT OF SOLAR-FLARE PROTONS. Reinhard, R.; Wibberenz, G. (Institut fuer Reine und Angewandte Kernphysik, Kiel). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The velocity dispersion for a large number of solar proton events is analyzed in the energy regime 10-60 MeV. It is found that the propagation can be separated into two components: one energy independent term describing propagation in the solar atmosphere, one interplanetary component giving a velocity dispersion $v \cdot t_m = \text{const}$ (t_m = time of intensity maximum). The additional study of time profiles, onset times and multi-space-probe observations shows that propagation in the solar atmosphere consists of three processes: an initially rapid transport across $\lesssim 60°$ in addition to slow diffusion and drift. (auth)

19682 (CONF-730804-P2, pp 1378-1383) DRIFT AND DIFFUSION OF SOLAR-FLARE PROTONS IN THE CORONA. Reinhard, R. (Institut fuer Kernphysik, Kiel); Roelof, E. C. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

A simplified two-parameter phenomenological model for coronal proton propagation is applied to the analysis of flare proton events. To demonstrate the existence of both deterministic (e.g., drift) and stochastic (e.g., diffusion) transport processes, a one-dimensional model in which the protons drift and diffuse in longitude is assumed. The distribution function for particles released at the flare is a Gaussian. This function predicts simple relationships between the times of onset and maximum intensity at a given longitude in the corona. When compared with 41 solar flare proton events (corrected for interplanetary diffusion effects), 20 events yield both drift times $\tau_c \sim 10^{-1}$ hr/deg and diffusion times $\tau_D \sim 10^{-3}$ hr/deg^2. (auth)

19683 (CONF-730804-P2, pp 1384-1389) EXPANDING MAGNETIC BOTTLES AND RELATIVISTIC ELECTRONS ASSOCIATED WITH SOLAR-PROTON FLARES. Sakurai, K. (Goddard Space Flight Center, Greenbelt, MD). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Using the observed data for type IV radio bursts, the onset time difference between the microwave and the metric emissions and the peak flux intensity of the metric component are analyzed as a function of the longitudinal position of associated flares on the sun. It is shown that this time difference is dependent on the position of associated flares and that the peak flux intensity reaches maximum when a flare occurs in the region 10 to 40 degrees west of the central meridian of the solar disk. These results are explained in terms of the eastward expansion of magnetic bottles which trap mildly relativistic electrons responsible for type IV bursts. (auth)

19684 (CONF-730804-P2, pp 1392-1397) SOLAR-PARTICLE PROPAGATION AND THE INTERPLANETARY ENVIRONMENT: A STUDY OF THE 18 NOV 1968 EVENT. Wibberenz, G. (Univ., Kiel); Lanzerotti, L. J.; Venkatesan, D. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Particles from the 18 Nov 1968 solar event were measured by spacecraft-based and ground-based instruments; near-earth data cover rigidities in the range 1-2000 MV. The first stage of the event, which shows two intensity increases, is studied. The first very rapid, highly anisotropic increase is seen at all energies and can be interpreted in terms of diffusive propagation with a mean free path of ≈ 0.1 AU for $P \approx 100$ MV. Power spectra of the interplanetary magnetic field show that the local degree of disturbance is very low and does not change drastically between the two periods. It is concluded that the second intensity increase is due to a different interplanetary particle population controlled by solar conditions. (auth)

19685 (CONF-730804-P2, pp 1398-1403) RISETIMES TO MAXIMUM FLUX OF SOLAR ELECTRON AND PROTON EVENTS AND THEIR RELATION TO THE INTERPLANETARY-FIELD POWER SPECTRUM. Lanzerotti, L. J. (Bell Labs., Murray Hill, NJ); Venkatesan, D.; Wibberenz, G. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The times to maximum flux of prompt solar electron and proton events from western hemisphere flares are used to estimate local values of the mean free path $\lambda_r(P)$ as a function of particle rigidity P. These values are compared with values of $\lambda_r(P)$ calculated from interplanetary field power spectra by Sari (1972). The values of $\lambda_r(P)$ obtained from the electron profiles are consistent with an extrapolation of Sari's spectra to lower rigidities. (auth)

19686 (CONF-730804-P2, pp 1404-1409) SOLAR COSMIC RAY FLARE OF SEPTEMBER 1, 1971. Vernov, S. N.; Kuznetsov, S. N.; Logachev, Yu. I.; Petrova, I. V.; Pisarenko, N. F.; Savenko, I. A.; Stolpovskii, V. G.; Vorobev, V. A. (Moscow State Univ.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The solar cosmic ray increase event of September 1-7, 1971 is considered for the protons in the 0.9 MeV-1.8 GeV energy range. The characteristic feature of the examined event was that the particle source (chromospheric flare) was on the Sun's remote side and, therefore, during the first 2.5 days the particles arrived as a result of the diffusion in undisturbed interplanetary medium the characteristics of which are traced for particles of various energies. (auth)

19687 (CONF-730804-P2, pp 1410-1415) GENERATION AND PROPAGATION OF SOLAR COSMIC RAYS DURING THE FLARES. Baisakalova, A. B.; Gainova, L. E.; Kobzev, V. A.; Kolomeets, E. V. (Kazakh State Univ., Alma-Ata, USSR). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The diffusion coefficients are determined for different periods of solar activity in various energy intervals by taking into account temporal variations of solar cosmic rays generated in flares. In the region of low energies, diffusion coefficients are determined in terms of the difference in drift times of electrons and protons. The calculations are made and it is shown that for a number of flares the trapping of charged high energy particles produced by flares takes place in the Sun's vicinity. The energy spectra and absolute electron fluxes are calculated for 13 events using the data on microwave and hard X-ray emission. The calculations of integral energy fluxes taken away by different types of electromagnetic and corpuscular emission are presented. A possible interpretation is given to observed effects. (auth)

19688 (CONF-730804-P2, pp 1416-1421) INTENSITY OSCILLATION OF LOW-ENERGY SOLAR PARTICLES OBSERVED ON THE IMP 7 SATELLITE. Fan, C. Y. (Univ. of Arizona, Tucson); Gloeckler, G.; Hovestadt, D. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Solar flare particles in the energy range from 125 to 160 keV per charge were detected and analyzed by an electrostatic deflection vs. energy instrument on board the Explorer 47 (IMP 7) satellite. A harmonic analysis of the counting rates shows that frequently, the fluctuation of the particle flux can be approximately represented by $N(t) = f(t) \sin 2\pi\nu t$ where f(t) is a smoothly varying function of t. The oscillation frequency ν varies from flare to flare and is of the order of 2×10^{-3} ~/sec. The physical implications of the finding will be discussed. (auth)

19689 (CONF-730804-P2, pp 1422-1425) BALLOON OBSERVATIONS OF RAPID VARIATIONS IN SOLAR PARTICLE FLUX DURING JULY 1972. Bagg, L. E.; Earl, J. A.; Luhmann, J. G. (Univ. of Maryland, College Park). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Solar energetic particles were observed with excellent time resolution with the aid of a large hodoscope flown on a balloon. This paper reports on a transient increase in the intensity of solar protons which can be interpreted in considerable detail as evidence for the coherent propagation of particles injected by a west limb flare occurring at 1025UT on July 22, 1972. (auth)

19690 (CONF-730804-P2, pp 1426-1431) WEST-LIMB PROTON FLARES: A TOOL FOR CLARIFYING THE PROPAGATION PROCESS. Barouch, E. (CEN de Saclay, Gif-sur-Yvette, France); Engelmann, J.; Gros, M.; Masse, P. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Several proton events associated with west limb flares have been observed. The interest of studying these flares is stressed, and the events of March 30th, 1969 and Nov. 2nd, 1969 are discussed in detail as an example. The relationship between the proton propagation characteristics and interplanetary disturbances in these two events is deduced. (auth)

19691 (CONF-730804-P2, pp 1432-1437) COMPARISON OF COSMIC-RAY ANISOTROPIES AND INTERPLANETARY MAGNETIC FIELD DATA LATE IN A SOLAR FLARE. Allum, F. R. (Univ. of Texas, Dallas); Palmeira, R. A. R.; McCracken, K. G.; Rao, U. R.; Fairfield, D. H.; Gleeson, L. J. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The detailed relationship between the anisotropy characteristics observed during late times ($t \gtrsim 4$ days) in the decay of a flare event and the interplanetary magnetic field parameters is studied. The direction of anisotropy at such times shows remarkable invariance with respect to the direction of magnetic field and is also independent of energy. The anisotropy always is from 45° east, a direction approximately perpendicular to the nominal Archimedean spiral. The amplitude of the anisotropy increases as the magnetic field azimuth shows greater departure from the radial direction. The reciprocal of the decay time constant shows a linear increase with the anisotropy amplitude. Theoretical implications of these results are noted. (auth)

19692 (CONF-730804-P2, pp 1440-1445) SIMULTANEOUS SATELLITE AND RIOMETER STUDIES. Baker, M. B.; Masley, A. J.; Satterblom, P. R. (McDonnell Douglas Astronautics Co., Huntington Beach, CA). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The expected 30 and 50 MHz riometer absorption was calculated for the 7 June, 25 September and 2 November 1969 solar events using data from the McDonnell Douglas charged particle experiment on the polar orbiting OGO-6 Satellite. Excellent agreement was found between measured polar cap riometer absorption during the events and absorption calculated from detailed particle data obtained on the satellite passing over the riometer. Electrons are found to contribute the greater part of the 30 MHz absorption before the peak of the 2 November 1969 event; at all other times protons produce most of the absorption. The alpha-particle contribution is negligible in all cases. (auth)

19693 (CONF-730804-P2, pp 1446-1451) TIME-AVERAGED FLUX OF SOLAR PROTONS AS MEASURED BY THERMOLUMINESCENCE STUDIES OF LUNAR ROCKS. Hoyt, H.; Walker, R.; Zimmerman, D. (Washington Univ., St. Louis). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Thermoluminescence (TL) measurements are used to obtain the ionization dose-rate depth profile in a lunar surface rock averaged over the TL half-life (3×10^3 y). Assuming a differential kinetic energy spectrum $dJ/dE \sim E^{-\gamma}$, a best fit is obtained for solar flare protons with $\gamma = 2.3 \pm 0.2$ and an omnidirectional (4π) integral flux above 10 MeV of 40-80 prot/cm^2 sec. (auth)

19694 (CONF-730804-P2, pp 1452-1457) NORTH-SOUTH ASYMMETRY OF SOLAR COSMIC-RAY INTENSITY IN POLAR CAPS. Darchieva, L. A.; Ivanova, T. A.; Sosnovets, E. N.; Tverskaya, L. V. (Moscow State Univ.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2

The features of 1 MeV solar proton and 50 keV electron penetration in the magnetospheric polar regions are studied on the basis of the data from the polar-orbiting satellite Cosmos-480. For 10 hours on April 10, 1972 the proton flux over the north cap was 10 times higher than that over the south cap. In the regions of the northern and southern auroral latitudes the 1 MeV proton intensity was comparable with that in the south cap region. The 50 keV electron intensity exhibited no difference in the polar caps. Mechanisms of solar cosmic ray penetration into the magnetosphere are discussed. (auth)

19695 (CONF-730804-P2, pp 1458-1463) ANISOTROPIC COSMIC-RAY INCREASES ON NOVEMBER 1970. Troncoso, O. (Univ. Nacional Autonoma de Mexico, Mexico City). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The cosmic-ray intensity during November, 1970, was studied using data from 26 recording stations over the world. On November 7, a moderate Forbush decrease was registered and is associated with a class 3B solar flare occurring on November 5 at 0308 UT. In the observed data one can also distinguish three peaks on November 20 and 21, observed during the recovery time of a small Forbush decrease. Six solar flares of importance 2B were observed in the four days preceding the onset of the small Forbush decrease on November 18; they are presumably responsible in modulating the cosmic ray intensity detected at ground level during recovery from Forbush decrease. The data indicate further that these anisotropic events are the direct results of the interaction of the cosmic rays with the quasi-spherical shock waves of solar origin. (auth)

19696 (CONF-730804-P2, pp 1464-1469) CHARGE COMPOSITION AND ENERGY SPECTRUM OF SOLAR FLARE VVH AND VH NUCLEI. Bhandari, N.; Goswami, J. N.; Lal, D.; Tamhane, A. S. (Physical Research Lab., Ahmedabad, India). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Results are discussed on the inferred long term averaged fluxes and kinetic energy spectra of very very heavy (VVH) and very heavy (VH) cosmic ray nuclei, $Z \geq 30$ and $Z > 20$ respectively, based on observations of fossil tracks in a variety of extraterrestrial samples-lunar and meteoritic. These samples have been irradiated to both solar as well as galactic cosmic rays during the past 10^9 years, with effective shielding depths of 0-10 cms of typical stony material, corresponding to kinetic energy interval, (0-2000) MeV/n. The observations show that (i) at energies <10 MeV/n, the VVH and VH nuclei are entirely of solar origin and (ii) the relative abundance of $(Z \geq 30)/(Z > 20)$ nuclei is almost the same over the wide kinetic energy interval (50-2000) MeV/n but that at lower energies, <25 MeV/n, the heavier nuclei progressively become more abundant. The ratio of abundance, $(Z \geq 30)/(Z > 20)$, increases by more than a factor of 5 in going down from 25 to 6 MeV/n. Taking into account typical erosion rates, the exponents in the power-law kinetic energy spectra of solar VH and VVH nuclei in space at 1 A.U. are determined to be approximately (-3) and (-5) respectively. One of the results discussed above, that the two so closely situated charge groups, VH and VVH have distinctly different kinetic energy spectra (that of VVH and nuclei being much steeper) should prove very important in understanding solar acceleration and escape propagation processes. (auth)

19697 (CONF-730804-P2, pp 1470-1473) CHARGE STATE OF LOW ENERGY Fe NUCLEI ACCELERATED BY SOLAR FLARES. Sullivan, J. D.; Price, P. B. (Univ. of California, Berkeley). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Using sounding rockets launched from Fort Churchill, Canada, the differential energy spectra of Fe in three solar flares between 0.3 and 50 MeV/nuc were measured. In one of these flares the geomagnetic field was undisturbed and the Fe spectrum showed a peak at ~2 MeV/nuc. Interpreting this observation with the established quiet time geomagnetic cutoffs, it was calculated that the charge of 2 MeV/nuc Fe is 22^{+1}_{-4} instead of the equilibrium value of ~16 for Fe in neutral matter. This non-equilibrium state of ionization imposes a constraint on the flare mechanism and suggests the importance of the flash-phase flare plasma for ionizing heavy nuclei prior to acceleration. (auth)

19698 (CONF-730804-P2, pp 1474-1478) OBSERVATION OF TRANS-IRON SOLAR FLARE NUCLEI IN AN APOLLO 16 COMMAND MODULE WINDOW. Shirk, E. K.; Price, P. B. (Univ. of California, Berkeley). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Trans-iron nuclei from the 18 April 1972 solar flare have been detected in one of the Apollo 16 Command Module windows. Measurements of 39 events with $Z \geq 32$ and 12 events with $Z \geq 44$ have been completed. The enhancement factor $Q(Z/Fe) \equiv [Z/Fe]_{sp}/[Z/Fe]_{\odot}$ is found to be $Q(Z \geq 32/Fe) = 40^{+\infty}_{-21}$ at $0.25 \leq E \leq 1.3$ MeV/amu and $Q(Z \geq 44/Fe) = 120^{+\infty}_{-61}$ at $0.6 \leq E \leq 2.0$ MeV/amu. The measurements place an upper limit $Q(Z > 60/Fe) < 1000$ at $0.1 \leq E \leq 1.0$ MeV/amu. When the data of Braddy et al. (1973) at Z = 2, 8, 26 for the same flare are included, it is found that Q(Z/He) may be represented by an exponential $Q \propto \exp[Z/Z_1(E)]$ where $Z_1(E)$ increases with energy. (auth)

19699 (CONF-730804-P2, pp 1479-1483) SYSTEMATICS OF HEAVY-ION ENHANCEMENTS IN SOLAR FLARES. Price, P. B.; Chan, J. H.; Crawford, H. J.; Sullivan, J. D. (Univ. of California, Berkeley). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Using Lexan and glass detectors, the composition of solar particles with $Z \geq 2$ were determined as a function of energy from ~0.2 to ~50 MeV/nucleon in four flares of quite different intensity and during a time when the sun was nearly quiet. Fe is nearly completely stripped. The enhancement factor $Q(Z,E) \equiv [Z/He]_{SP}/[Z/He]_{\odot}$ increases with Z at a given energy but decreases with energy. Heavy element enhancements are detectable at higher energies in stronger flares. They occurred in ancient as well as in present-day flares. Li and Be were observed in one flare. Incomplete ionization, preferential leakage of heavy ions, energy loss by ionization, and nuclear reactions appear to be involved in solar particle production. (auth)

19700 (CONF-730804-P2, pp 1486-1491) ENRICHMENT OF HEAVY NUCLEI IN THE APRIL 17, 1972 SOLAR FLARE. Fleischer, R. L.; Hart, H. R. Jr.; Renshaw, A.; Woods, R. T. (General Electric Research and Development Center, Schenectady, NY). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Cosmic ray nuclei from the April 17, 1972 solar flare were recorded in polycarbonate plastic and phosphate glass track detectors exposed on the Apollo 16 flight. The energy spectra of iron group nuclei and of carbon and heavier nuclei were measured down to ~0.02 MeV/nucleon, revealing that the enrichment of iron relative to carbon and heavier nuclei increases markedly in this very low energy region. (auth)

19701 (CONF-730804-P2, pp 1492-1497) DIRECT OBSERVATIONS OF THE CHARGE STATES OF LOW-ENERGY SOLAR PARTICLES. Gloeckler, G. (Univ. of Maryland, College Park); Fan, C. Y.; Hovestadt, D. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The charge states of carbon and oxygen of solar origin have been measured directly in interplanetary space. At 100 keV per nucleon the C^{+5}/C^{+6} and O^{+7}/O^{+8} ratios are 1.8 and 1.6 respectively. The abundance ratios of low energy heavy nuclei to He were significantly larger than corresponding photospheric values. The enhancement of O/He is 35 and both Si/He and Fe/He are overabundant by a factor of 100. To explain these observations a mechanism is proposed which first preferentially accelerates heavy ions and is followed by either storage of these ions in the coronal regions or strong adiabatic deceleration. (auth)

19702 (CONF-730804-P2, pp 1498-1503) MEASUREMENT OF ELEMENTAL ABUNDANCE OF VERY LOW-ENERGY SOLAR COSMIC RAYS. Hovestadt, D.; Vollmer, O.; Gloeckler, G.; Fan, C. Y. (Max-Planck-Institut fuer Extraterrestrische Physik, Garching, Ger.). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Heavy interplanetary particles ($3 < Z < 30$) have been observed during a solar flare period between October 29 and November 4, 1972. The nuclear abundance has been determined by a two parameter analysis (dE/dx vs E technique) of a thin window proportional counter–solid state detector device aboard the Explorer 47 (IMP-7) satellite. Energy spectra are given for C, O and Fe. The elemental abundance relative to oxygen is determined for carbon, neon, magnesium, silicon and the iron group in the energy range 0.62 to 6.9 MeV/nucleon. For the Fe/O ratio no energy dependence could be observed within the error limits. (auth)

19703 (CONF-730804-P2, pp 1504-1509) TIME VARIATIONS AND ANGULAR DISTRIBUTIONS OF ALPHA PARTICLES AND MEDIUM NUCLEI FOR THE OCTOBER 27, 1972 SOLAR-PARTICLE EVENT. Armstrong, T. P. (Univ. of Kansas, Lawrence); Krimigis, S. M. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Energy spectra and angular distributions of protons, alpha particles, and medium nuclei have been obtained with the JHU/APL experiment on IMP 7 for the event which began on October 27, 1972. The ratio of the number of alpha particles to the number of M group (CNO) nuclei in the 1.6–3.2 MeV/nuc. interval varied from 20 to 115 in the 6 hour period on October 31 including a SSC. Measurement of the proton to alpha flux ratio in the same velocity interval and time period showed a variation from about 90 to 130. During this period of time the proton, alpha and M nuclei directional fluxes showed nearly identical directions but differing anisotropy amplitudes. The variation of the alpha/medium ratio in the neighborhood of the SSC event is attributed to some combination of propagation and residual source effects. (auth)

19704 (CONF-730804-P2, pp 1510-1515) MEASUREMENTS OF THE RELATIVE ABUNDANCES OF Fe-GROUP, He, AND M NUCLEI DURING THE OCTOBER 29, 1972 SOLAR-PARTICLE EVENT. Krimigis, S. M. (Johns Hopkins Univ., Silver Spring, MD); Armstrong, T. P. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Data obtained from the JHU/APL experiment on Explorer 47 are used to obtain measurements of the time variation of the α/M and Fe-group/O ratios during the October 29, 1972 solar particle event. It is shown that (a) The α/M ratio in the range 1.6 to 3.2 MeV/nucleon varied by a factor of $\gtrsim 5$ during the event with the largest value (75.3) observed in association with the sudden commencement on October 31. (b) The overall increase in the p/α ratio during the same event was only a factor ~2, in a similar energy/nucleon interval. (c) The Fe-group/O ratio in the range 3.3 to 7.6 MeV/nucleon varied by a factor $\gtrsim 11$, with the largest value (0.28) observed at the time of Fe-group maximum intensity. The intensity-time profile of nuclei with $Z \gtrsim 20$ is being reported for the first time. It is concluded from the observations that the particle rigidity is not the most significant parameter in particle propagation in the interplanetary medium. Further, relative abundances of particle species observed in the interplanetary medium cannot be easily related to elemental composition in the solar source region. (auth)

19705 (CONF-730804-P2, pp 1516-1521) PIONEER 10 MEASUREMENTS OF THE ISOTOPIC COMPOSITION OF SOLAR COSMIC RAYS DURING AUGUST 1972. Webber, W. R. (Univ. of New Hampshire, Durham); Roelof, E. C.; McDonald, F. B.; Teegarden, B. J.; Trainor, J. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

For the first time the isotopic composition of solar cosmic ray C, N, O, Ne, Mg, and Al nuclei were measured during the August series of solar events. In these events ^{3}He nuclei in the energy range 6–66 MeV/nuc were also measured. The maximum observed ^{3}He abundance in this energy range is between 1–2% of that for ^{4}He, and assuming that all of this ^{3}He is produced by fragmentation of energetic ^{4}He nuclei, an upper limit ~0.2 g/cm^2 is obtained for the amount of material traversed in the solar atmosphere. Subject to this matter limit only the ^{15}N among the heavier isotopes can be accounted for by fragmentation in the solar atmosphere. The abundance ratios [(^{12}C/^{13}C = 58 ± 38, ^{16}O/^{18}O = 99 ± 68, ^{20}Ne/^{22}Ne = 8 ± 5, ^{24}Mg/^{26}Mg = 10 ± 6,)] that were observed are all therefore presumably indicative of the composition of the solar atmosphere and are in agreement with the terrestrial abundances of these isotopes. (auth)

19706 (CONF-730804-P2, pp 1522-1525) RELATIVE ABUNDANCES OF NUCLEI WITH $2 \leq Z \leq 36$ IN SOLAR FLARES. Sullivan, J. D.; Crawford, H. J.; Price, P. B. (Univ. of California, Berkeley). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The composition of heavy nuclei with $2 \leq Z \leq 36$ at energies above 15 MeV/nuc was measured in solar flares on 25 January

1971, 2 September 1971, and 4 August 1972 by analyzing tracks in Lexan stacks exposed in rockets. The ratios He/Si, S/Si, and Ar/Si are all lower by at least a factor three than the ratios in the sun and solar system. The O/Fe ratio varies from ~10 to 30 from one flare to another. In the 4 August 1972 flare a finite flux of the elements with Z ~ 36 was observed and an upper limit of ~0.01 for the abundance ratio LiBeB/CNO was set. (auth)

19707 (CONF-730804-P2, pp 1526-1531) VARIATIONS IN THE NUCLEAR ABUNDANCES IN SOLAR-PARTICLE EVENTS. Bertsch, D. L.; Biswas, S.; Fichtel, C. E.; Pellerin, C. J.; Reames, D. V. (Goddard Space Flight Center, Greenbelt, MD). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Measurements of the flux of helium nuclei in the 24 January 1971 event and of helium and (C,N,O) nuclei in the 1 September 1971 event are combined with previous measurements to obtain the relative abundances of helium, (C,N,O), and Fe-group nuclei in these events. These data are then summarized together with previously reported results to show that, even when the same detector system using a dE/dx plus range technique is used, differences in the He/(C,N,O) value in the same energy/nucleon interval are observed in solar cosmic ray events. Further, when the He/(C,N,O) value is lower the He/(Fe-group nuclei) value is also systematically lower in these large events. (auth)

19708 (CONF-730804-P2, pp 1532-1537) ENRICHMENT OF HEAVY NUCLEI IN SOLAR COSMIC RAYS. Dobrotin, N. A.; Kurnosova, L. V.; Razorenov, L. A.; Fradkin, M. I. (Lebedev Inst. of Physics, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The events of heavy nuclei generation on the Sun are considered. The authors compare the experimental results obtained by them for nuclei with the energy E 400-600 MeV/nucleon with the data reported by A. Mogro-Campero and J. A. Simpson for nuclei in the energy interval 10-60 MeV/nucleon. (auth)

19709 (CONF-730804-P2, pp 1538-1542) ABUNDANCES OF SOLAR COSMIC-RAY NUCLEI OF OXYGEN TO IRON IN JANUARY 24, 1971 EVENT. Nevatia, J.; Durgaprasad, N.; Biswas, S. (Tata Inst. of Fundamental Research, Bombay). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

A stack of cellulose triacetate (CTA) sheets each of thickness 125 microns was exposed to solar particle radiation in a rocket flight from Fort Churchill, Canada at 1512 hours U. T. on January 25, 1971, when the mean particle intensity associated with the 1B flare was close to the maximum value. The detector was exposed to the ambient radiation without shielding material so that very low energy particles were recorded in the upper sheets. The upper six sheets of CTA were etched and measurements were made on about 600 tracks due to oxygen and heavier nuclei. The charge composition and energy spectra of nuclei with Z = 8 – 26 have been measured in the energy interval of about 2 to 30 MeV/nucleon. The data obtained in this work will be combined with the results obtained in the same flight on nuclei with Z ≥ 12 in the lexan stack by the Berkeley group, and will be compared with the solar particle composition results by other investigators. (auth)

19710 (CONF-730804-P2, pp 1543-1547) RELATIVE ABUNDANCES AND ENERGY SPECTRA OF SOLAR COSMIC-RAY NUCLEI IN THE AUGUST 4, 1972 EVENT. Biswas, S.; Bertsch, D. L.; Fichtel, C. E.; Pellerin, C.; Reames, D. V. (Goddard Space Flight Center, Greenbelt, MD). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Measurements of the energy spectra and the relative abundances of energetic solar protons, helium, (C,N,O) and heavy (Z = 10–26) nuclei have been made in emulsion stacks exposed in a rocket flight from Fort Churchill, Canada at 1916 hours U. T. on August 4, 1972, about 13 hours after the onset of the large optical flare. The integral energy spectrum of protons is measured in the 3-65 MeV interval. The differential spectrum of C,N,O nuclei has been measured in the energy interval from 8 to 80 MeV/N. In this event the flux of C,N,O nuclei at 15 MeV/N was 30 times that in the Jan. 25, 1971 event and at 40 MeV/N it was about 200 times that in the Sept. 2, 1971 event. The helium flux is measured in the 24-55 MeV/N interval and the ratio of He/(C,N,O) nuclei is obtained as 40 ± 7. The relative abundance of (C,N,O) to (Ne-Ni) nuclei in the 9.5–32 MeV/N interval is observed to be 7.4 ± 0.8. Further results on the details of the relative abundances of solar cosmic ray nuclei in this largest heavy nuclei event recorded so far will be presented and some of the implications will be discussed. (auth)

19711 (CONF-730804-P2, pp 1548-1553) COMPOSITE CATALOG OF GROUND-LEVEL COSMIC-RAY INCREASES. Shea, M. A.; Smart, D. F. (Air Force Cambridge Research Labs., Bedford, MA). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

A catalog of the 18 ground-level cosmic-ray increases detected by neutron monitors between 1956 and 1971 has been compiled. Each of the principal investigators was requested to examine their original records to select the onset times, times of maximum intensity, magnitude and duration of each event. From these data a composite listing for each event has been assembled detailing the station with the earliest onset time, the largest increase at sea level, and the longest duration. It is noted that for some events both the earliest onsets and largest increases are reported from stations in the Southern Hemisphere whereas scientific publications are often biased toward commonly used Northern Hemisphere stations. These early onsets are consistent with solar particle propagation along the Archimedes spiral path between the sun and the earth. (auth)

19712 (CONF-730804-P2, pp 1554-1559) EVIDENCE FOR VERY HIGH-ENERGY SOLAR-PARTICLE PRODUCTION. Schindler, S. M.; Kearney, P. D. (Colorado State Univ., Fort Collins). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Results of the 3 Oct. 1971 very high-energy solar particle event (as detected by the C.S.U. Underground Solar Cosmic Ray Experiment) are discussed using updated particle and x-ray data. Evidence for particle acceleration occurring during the early phase of the solar flare is presented. (auth)

19713 (CONF-730804-P2, pp 1560-1569) RELATIVISTIC COSMIC RAYS FROM THE SUN'S INVISIBLE DISK. Duggal, S. P.; Pomerantz, M. A. (Bartol Research Foundation, Swarthmore, PA). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The arrival at the earth of relativistic nuclear particles of solar origin has been recorded on two dozen occasions. Out of these, only four events have been ascribed to sources beyond the limb. However, the most recent and unusual of this rare phenomenon that occurred on September 1, 1971, displayed an unexpected and marked anisotropy for several hours following onset. An analysis of pitch angle distributions has revealed that for an invisible disk event for which the anisotropy is resolvable, the axis of symmetry corresponds to the arrival of particles from the direction of the garden hose field lines. The study has further shown that during the event of January 28, 1967, a 100% anisotropy existed during the initial stage of arrival of the relativistic particles from the invisible disk of the sun. The long duration of the anisotropy recorded during the invisible disk solar cosmic ray event of September 1-2, 1971, and the excellent fit of the observed distribution to theoretical predictions over the entire range of pitch angles, provided a unique opportunity for determining the nature of its evolution from onset to the isotropic stage. Data from eight appropriately selected high latitude stations were utilized for determining the axis of symmetry in successive intervals. Data from the Bartol network have been analyzed in terms of the anisotropic diffusion with boundary (ADB) model. The results yield good fit of the observations for both the pre-maximum and post-maximum phases of this event. The injection time at the source and the angular separation of the invisible disk flare site from the base of the Archimedian spiral interplanetary magnetic field line that connects the sun with the earth was determined for the September 1-2, 1971 GLE. The location of the parent flare is found to be consistent with the known position of McMath region 11482. These investigations have revealed a basic symmetry in the location of the parent flares with respect to the foot of the garden hose field line. (auth)

19714 (CONF-730804-P2, pp 1570-1575) NEUTRON MODERATED DETECTOR AND THE DETERMINATION OF RIGIDITY DEPENDENCE OF PROTONS FROM THE SEPTEMBER 1-2, 1971 SOLAR FLARE. Mischke, C. F. W.; Stoker, P. H.; Duvenage, J. (Potchefstroom Univ. for C. H. E., South Africa). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

A single Chalkriver BP28 proportional neutron counter surrounded by 7.5 cm paraffin wax, recorded low energy cosmic ray neutrons near sea level at Sanae (1.02 GV cutoff) from May 1971 onwards. From latitude surveys made by aircraft with a similar neutron detector on board, a differential response function was deduced for sea level. The validity of this function was verified by comparing observed and calculated fractional variations in sea level counting rates due to eleven year modulation and Forbush decreases, and to give consistent results regarding the rigidity dependence of protons from the solar flare of 1/2 September 1971. (auth)

19715 (CONF-730804-P2, pp 1577-1582) SOLAR NEUTRON PRODUCTION DURING THE EVENTS ON 4 AND 7 AUGUST 1972. Reppin, C.; Chupp, E. L.; Forrest, D. J.; Suri, A. N. (Univ. of New Hampshire, Durham). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Observation of the 2.2-MeV neutron-proton capture and other gamma-ray lines has been made on the OSO-7 satellite during portions of the solar events starting at 0622 UT on 04 August and 1538 UT on 07 August 1972. The observed time history and the flux of the 2.2-MeV line on 04 August requires the capture of a total of $\sim 4 \times 10^{29}$ thermal neutrons over a time period of ~600 sec and a hydrogen number density greater than $10^{11} cm^{-3}$ in the region where the 2.2-MeV photons are produced. Consideration of neutron propagation, slowing down, and capture lead to a neutron production rate of 1.3×10^{27} sec^{-1} for the event. Independent calculations of the proton interaction rate required to produce the other measured gamma-ray lines result in the same production rate of neutrons. The total number of neutrons in the energy range 10-100 MeV near the earth is estimated to 20 neutrons cm^{-2} on 04 August and about 30-50 neutrons cm^{-2} for 07 August arriving over a time period of 3000 sec. The feasibility of measuring the resulting neutron fluxes is discussed. (auth)

19716 (CONF-730804-P2, pp 1583-1588) SEARCH FOR SOLAR NEUTRONS FROM 10 TO 100 MeV. Moon, S.; Simnett, G. M.; White, R. S. (Univ. of California, Riverside). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

A search for solar neutrons is reported from a balloon flight launched from Palestine, Texas on September 26, 1971. The sun was observed from 8:30 to 19:30 CST. The neutrons were detected with a telescope consisting of two 0.5 m^2 scintillation detectors spaced 1 meter apart using a double scattering-time of flight technique. Upper limits for solar neutrons in the energy intervals 10-30, 30-50, and 50-100 MeV are 1.1×10^{-4}, 2.6×10^{-4} and 5.9×10^{-4} neutrons/cm^2-sec respectively. These are combined into an overall upper limit of 5.1×10^{-4} neutrons/cm^2-sec. (auth)

19717 (CONF-730804-P2, pp 1590-1594) NUCLEAR GAMMA RAYS FROM SOLAR FLARES. Ramaty, R.; Lingenfelter, R. E. (Goddard Space Flight Center, Greenbelt, MD). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The theory of gamma ray line emission from solar flares is discussed. The formation process of the 2.23 MeV and 0.51 MeV lines is emphasized. Estimates of the spectrum and total number of protons in the flare as deduced from the gamma ray observations are given. (auth)

19718 (CONF-730804-P2, pp 1595-1601) GAMMA-RAY EMISSIONS FROM McMATH REGION 11976 DURING AUGUST 1972. Chupp, E. L.; Forrest, D. J.; Suri, A. N.; Reppin, C. (Univ. of New Hampshire, Durham). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

In an attempt to determine correlation of x-ray burst magnitude with γ-ray magnitude gamma ray lines were searched for during several events occurring in the first two weeks of August in which the SolRad X-ray class was $\geq$ M4, i.e. emitting $\geq 4 \times 10^{-2}$ ergs cm^{-2} sec^{-1} in the 1-8 Å band. A search has also been made for line emission before and after optical flares and during hard X-ray bursts not associated with reported optical flares. The only two cases of observable gamma lines above a flux level of 2×10^{-2} photons cm^{-2} sec^{-1} occurred on August 4, 1972 (0623-0632 UT) and August 7, 1972 (1538-1547 UT). A crude correlation has been made between the hard X-ray flux (60-120 keV) and the gamma ray flux. (auth)

19719 (CONF-730804-P2, pp 1602-1606) SOLAR WIND, COSMIC RAYS, AND SOLAR NEUTRINOS. Kocharov, G. E. (Ioffe Inst. of Physics and Tech., Leningrad). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

An attempt is made at complex consideration of three problems: (1) solar neutrinos, (2) nuclear reactions on the surface of the Sun and the helium and hydrogen isotopes in solar cosmic rays, and (3) the isotopic composition of the solar wind. (auth)

19720 (CONF-730804-P2, pp 1607-1612) ACCELERATION OF ELECTRONS DURING THE FLASH PHASE OF SOLAR FLARES. Kane, S. R. (Univ. of California, Berkeley). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Characteristics of the electron acceleration process operating during the flash phase of solar flares are deduced from the high time resolution observations of impulsive solar X-rays $\gtrsim$10 keV and other flash phase emissions from small solar flares (H_α-importance $\lesssim$1). The results are summarized in a table. Implications of these findings are discussed. (auth)

19721 (CONF-730804-P2, pp 1613-1617) MEASUREMENTS OF THE FLUX OF LOW-ENERGY SOLAR-FLARE POSITRONS. Hurford, G. J.; Mewaldt, R. A.; Stone, E. C.; Vogt, R. E. (California Inst. of Tech., Pasadena). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

New upper limits to the flux of solar-flare positrons in the energy range 0.2-2 MeV are reported. The observations were made during four solar-particle events in late 1972, with the Caltech Electron/Isotope Spectrometer on IMP-7. The 0.2-2 MeV positron flux is compared directly to the solar-flare electron (0.2-2 MeV) and proton (1.2-27.5 MeV) fluxes measured in the same detector system. Summing over four solar events, $e^+/(e^+ + e^-) < 6 \times 10^{-3}$ was found. Calculated fluxes of solar-flare positrons for these four events are well below the upper limits. (auth)

19722 (CONF-730804-P2, pp 1618-1623) OBSERVATION OF 38- TO 344-keV INTERPLANETARY PROTONS DURING QUIET TIMES. Anderson, K. A.; Lin, R. P.; McGuire, R. E. (Univ. of California, Berkeley). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The first observations of quiet time interplanetary protons in the energy range 38 to 334 keV from the Apollo 16 subsatellite are presented. These proton fluxes vary by a factor of ~5 over a six month period. Their spectrum can be represented by a power $dJ/dE = 2.8\ E^{-1.2}$ (cm^2 sec ster keV)$^{-1}$ from 38 to 334 keV during May, 1972. The origin of these protons is discussed in view of the energy change processes of adiabatic deceleration, Fermi acceleration and dE/dx, which should be operative in this energy range. (auth)

19723 (CONF-730804-P2, pp 1624-1629) OBSERVATIONS OF 38- TO 344-keV PROTONS AND 2- TO 100-keV ELECTRONS IN SOLAR EVENTS. Lin, R. P.; McGuire, R. E.; Anderson, K. A. (Univ. of California, Berkeley). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The first observations of protons down to 38 keV and electrons down to $\lesssim$2 keV during a solar particle event are presented. The observations are from the Apollo 15 Subsatellite during a flare event which began on September 1, 1971. Estimates of the diffusion coefficient for the low energy (~.04-2.0 MeV) protons of ~1 to 5.3×10^{20} cm^2/sec at 1 A. U. are made. The effects of adiabatic deceleration and dE/dx energy loss in the corona are discussed. (auth)

19724 (CONF-730804-P2, pp 1632-1637) COROTATING PARTICLE FLUXES OBSERVED WITH THE PIONEER 7 AND IMP 4 SPACECRAFT. McKibben, R. B. (Univ. of Chicago). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Observations are reported of the time development of 17 MeV proton fluxes in 4 corotating particle streams during the 5 days required for corotation from Pioneer 7, about 70° E of Earth in 1968, to IMP-4 at Earth. The azimuthal width of the particle

streams was observed to remain constant over the 5 days. Assuming either continuous or impulsive injection of particles at the sun, this observation is shown to imply that $\kappa_\perp$ was significantly less than the $\kappa_\perp$ derived from recent solar flare observations (McKibben, 1972). (auth)

19725 (CONF-730804-P2, pp 1638-1643) CONNECTION OF ENERGETIC STORM PARTICLE EVENTS TO INTERPLANETARY MAGNETIC FIELD DISCONTINUITIES. Kunstmann, J. (Univ., Hamburg); Wibberenz, G. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Energetic storm particle (ESP) events are analyzed with respect to the interplanetary plasma and magnetic field configuration. It is shown that the ESP-events cannot be described by acceleration processes related to the shock motion or to the region of high fluctuations immediately behind the shock. The increase in the ESP population is observed several hours after arrival of the shock, it is more closely related in time to the occurrence of large directional changes of the interplanetary magnetic field. This confirms the picture obtained from galactic cosmic ray Forbush-decreases, which are in many cases coincident with ESP-events: an extended tangential discontinuity acts as a barrier for energetic particles from both sides. The observations are discussed with respect to various models of ESP-events. (auth)

19726 (CONF-730804-P2, pp 1644-1649) LOW ENERGY, HEAVY COSMIC-RAY NUCLEI DURING A SOLAR QUIET TIME. Woods, R. T.; Hart, H. R. Jr.; Fleischer, R. L. (General Electric Research and Development Center, Schenectady, NY). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Glass detectors were exposed on Apollo 17, 11-13 December, 1972. These detectors yield the energy spectra of heavy nuclei ($Z > 10$) in a new range: $0.02 < E < 0.4$ MeV/amu. Satellite proton data (IMP-7) recently made available indicate that, contrary to the title, this was not a solar quiet time; a small enhancement of 1 MeV protons was observed. For one glass detector exposed in the shade the differential energy flux is found to be $6.33 \times 10^{-5} E^{-2.3\,(+1.2\,-\,0.9)}$ (cm^2-sec-ster-MeV/amu)$^{-1}$ for $0.06 < E < 0.4$ MeV/amu. Detectors of identical glasses exposed facing the sun and facing away from the sun showed a 2:1 ratio in track densities, respectively. These results strongly suggest that these nuclei are solar in origin. (auth)

19727 (CONF-730804-P2, pp 1650-1654) CHARGE COMPOSITION AND ENERGY SPECTRUM OF SUPRATHERMAL SOLAR PARTICLES. Chan, J. H.; Price, P. B.; Shirk, E. K. (Univ. of California, Berkeley). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

During the Apollo 12 mission (14 to 24 Nov 1969) when the counting rate of 1 to 2 MeV/nucleon He was occasionally up to $\sim 10^3$ times higher than the quiet rate, the Fe/He ratio was found to be ~0.01 in the interval 0.5 to 5 MeV/nucleon, or enhanced by ~ 30 ± 10 times over the photospheric Fe/He ratio. During the Apollo 17 mission a small Lexan stack was exposed on the moon from 11 to 13 Dec 1972. On 12 Dec the counting rate of 1 MeV/nucleon He went up by ~10X. From ~ 0.5 to ~ 10 MeV/nucleon an abundance ratio He:CNO:[Z > 20] = 500:25:1 and spectra $\propto E^{-5}$ were measured. The O/(C + N) ratio is $\gtrsim 1.6$, which implies a solar origin. At energies below 0.5 MeV/nucleon the abundances of heavy elements appear to be increasing with decreasing energy. (auth)

19728 (CONF-730804-P2, pp 1656-1661) MEASUREMENTS OF THE QUIET-TIME LOW-ENERGY PROTON, ALPHA, AND M-NUCLEI COMPONENT IN COSMIC RAYS. Krimigis, S. M. (Johns Hopkins Univ., Silver Spring, MD); Armstrong, T. P.; Kohl, J. W. 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

Observations of the "quiet-time" energy spectrum of protons, helium, and medium nuclei are reported, which were obtained with the JHU/APL experiment on the near-circular orbiting (32 by 38 Re) Explorer 47 spacecraft during a 30-hour period on October 1-2, 1972. The following represents a summary of the observations: (a) The differential spectrum of protons and helium nuclei below ~4 MeV/nucleon may be described by $dj/dE = KE^{-3.0}$; the p/α ratio in this energy range is ~9. (b) The data suggest that a C,N,O component similar to those of protons and helium exists over the same energy range. (c) An unusual peak in the helium spectrum is present in the range 4.3-11.5 MeV/ nucleon, the intensity of which approaches that of protons in the same energy range. (d) An upper limit to the intensity of Fe-group nuclei of $< 1.3 \times 10^{-6}$ (cm^2 sec sr MeV/nucleon)$^{-1}$ in the range 3.3-7.6 MeV/nucleon has been established. (e) The low energy (0.29-0.5 MeV) proton component exhibits an anisotropy with the maximum intensity directed away from the sun, and an amplitude of ~28%, although the spacecraft is imbedded in the distant magnetotail. Although the intensity of the low energy component is below that of the 1965 solar minimum spectrum, the present observations are not considered to be the solar-modulated 1965 spectrum. (auth)

19729 (CONF-730804-P2, pp 1680-1684) COSMIC-RAY VARIATIONS IN AUGUST 1972. Kodama, M.; Murakami, K.; Wada, M. (Inst. of Physical and Chemical Research, Tokyo). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

A ground level solar particle event with its maximum at 1500-1600 UT on August 4, 1972 is studied in relation to the solar protons measured in space. The spectrum is estimated to be very soft, and this event at ground is only one to two orders higher flux of solar protons than ever observed. From a comparison with the July 17, 1959 event, the isotropy and slow rise time are interpreted by the situation that the Earth is between two shock fronts in which the particles diffuse uniformly. (auth)

19730 (CONF-730804-P2, pp 1702-1707) ENERGY SPECTRA AND THE CONDITIONS OF PROPAGATION IN THE INTERPLANETARY SPACE FOR SOLAR PROTONS DURING THE COSMIC-RAY EVENTS OF AUGUST 4-9, 1972. Bazilevskaya, G. A.; Stozhkov, Yu. I.; Charakhchyan, A. N.; Charakhchyan, T. N. (Lebedev Inst. of Physics, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

The solar proton fluxes were recorded on August 4-9, 1972 in the stratosphere with balloons. The measurements carried out at the North and South hemispheres showed an absence of the North-South anisotropy. The maximum recorded intensity of solar proton with energy more than 200 MeV was of about 50 cm^{-2} sec^{-1} ster^{-1}. The integral spectra of solar protons had the mean exponent $\gamma \approx 6$ on August 4 and 5, and $\gamma \approx 3$ on August 8 and 9 in a power law representation over a range from 200 to 500 MeV. The unusual time dependence of the events indicate the complex pattern of the interplanetary magnetic field. (auth)

19731 (N-73-32553) BACKGROUND OF THE COMPLETED RESEARCH: RELEVANCES TO SOLAR PHYSICS. Final Technical Report, September 1973. Sellin, I. A. (Tennessee Univ., Knoxville (USA)). Sep 1973. 15p. (NASA-CR-135704). NTIS $3.00.

Research activities reported consider the atomic structures of highly stripped heavy ions and their modes of formation and destruction in collisions. The lifetime of the metastable 2 3p 1 state of the two electron ion F VIII (+) was determined by measuring the radiative decay of an excited helium-like fluorine beam. Metastable state quenching measurements were performed on a helium-like ion to obtain the 1 1SO to 2 3p2 transition probability. Exponential exchange state dependence of x-ray production cross sections was studied in heavy target atoms during collisions with light charged particles. (STAR)

19732 (N-74-10758) SOLAR PROTON FLUENCES AS OBSERVED DURING 1966-1972 AND AS PREDICTED FOR 1977-1983 SPACE MISSIONS. King, J. H (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Nov 1973. 46p. (NASA-TM-X-70508). NTIS $4.50.

The probability with which any given proton fluence level will be exceeded during a space mission is computed for missions to be flown during the active phase of the next solar cycle (1977-1983). This probability is a function of fluence level, proton energy threshold, and mission duration. Data on the major solar proton events of 1966-1972 are given; it is argued that only this data set (and not that of the previous solar cycle) is appropriate for estimating next-cycle fluences. Probable numbers of each of the two types of events are estimated from Burrell's extension of Poisson statistics. Fluences of all future anomalously large events are assumed to have a common spectrum, that given by the August 1972 event. Fluences of the ordinary events are assumed to obey a log normal distribution. It is shown that for much of the confidence-level mission-duration regime of interest, at least one anomalously large event will occur; and given such

an occurrence, the ordinary-event contribution to mission fluence is negligible. (auth) (Star)

19733 (N-74-15476) NEUTRON PROPAGATION AND 2.2-MeV GAMMA-RAY LINE PRODUCTION IN THE SOLAR ATMOSPHERE. Wang, H. T.; Ramaty, R. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Jan 1974. 20p. (NASA-TM-X-70568). NTIS $3.00.

The 2.2 MeV gamma-ray line intensity from the Sun was calculated using a Monte Carlo method for neutron propagation in the solar atmosphere. Detailed results are provided on the total gamma-ray yield per neutron and on the time profile of the 2.2-MeV line from an instantaneous and monoenergetic neutron source. The parameters which have the most significant effects on the line intensity are the energies of the neutrons, the position of the neutron source on the Sun, and the abundance of ^{3}He in the photosphere. For an isotropic neutron source which is not too close to the limb of the Sun, the gamma-ray yield is between about 0.02 to 0.2 photons per neutron, provided that the neutron energies are in the range 1 to 100 MeV and the ratio ^{3}He/H is less than about .00005. (auth) (STAR)

19734 (SLA-74-104) SOLAR ULTRAVIOLET IRRADIANCE AND OZONE PARTICLE CONCENTRATION OBSERVATIONS AT 48 KILOMETERS BALLOON-FLOAT ALTITUDE. Schellenbaum, R. L. (Sandia Labs., Albuquerque, N. Mex. (USA)). May 1974. Contract AT(29-1)-789. 10p. Dep. NTIS $4.00.

Observations of solar ultraviolet irradiance in the Hartley Band were made with a balloon-borne filter wheel photometer at 42 to 48.5 km float-altitude during sunrise. Solar flux measurements were obtained at four wavelengths during a period of three hours. Total slant ozone column concentrations and ozone particle concentrations as a function of solar zenith angle were derived and found to compare favorably with other experimental results. The effects of ozone photodissociation and recombination are noted. (auth)

19735 FOREIGN INCLUSIONS IN STONY METEORITES. Pt. II. Rare Gases and Oxygen Isotopes in a Carbonaceous Chondritic Xenolith in the Plainview Gas-Rich Chondrite. Wilkening, L. L.; Clayton, R. N. (Univ. of Chicago). Geochim. Cosmochim. Acta; 38: No. 6, 937-945(Jun 1974).

Measurements of oxygen and rare-gas isotopes in a carbonaceous xenolithic inclusion in the Plainview H5 chondrite indicate that the xenolith and Plainview host are of two distinct meteorite types, and that no isotopic exchange has taken place between the two materials since their juxtaposition. The oxygen isotope analysis of the xenolith yields δ-^{18}O value of 6.5 ± 0.1 ‰ relative to SMOW, a value similar to that of carbonaceous chondrites (C2). Rare gas contents of the xenolith are also similar to those of carbonaceous chondrites. The radiation ages of the xenolith (2.9 ± 0.4 Myr) and the host (2.8 ± 0.4 Myr) are identical. Analyses of the rare gases in a sample of the host material adjacent to the xenolith show that Plainview is gas-rich, i.e., it contains large amounts ($52{,}300 \pm 10^{-6}$ cm^3 STP/g ^{4}He) of solar-type trapped gases. Carbonaceous chondritic material may be more prevalent in the asteroid belt than previously suspected. (auth)

19736 PHOTOMETER AND SPECTROMETER FOR SOLAR X RADIATION. Hlond, M. (Zaklad Astronomii, Wroclaw). Postepy Astron.; 22: No. 2, 109-123(Jun 1974). (In Polish).

A discussion of problems concerning the design and construction of solar x-ray photometers and spectrometers for the soft range radiation measurements, is given. (auth)

19737 SOLAR WIND AS A THREE-DIMENSIONAL FLOW. Sroczynska, M. (Zaklad Astronomii, Wroclaw). Postepy Astron.; 22: No. 2, 125-132(Jun 1974). (In Polish).

A method describing deviations of the solar wind from spherical symmetry (due for instance to solar rotation or to the inhomogeneous distribution of active centers on the disk) is given. It was assumed that the deviations are small and that each of the sources causing a deviation possesses axial symmetry. (auth)

19738 INFLUENCE OF SOLAR ACTIVITY ON THE STRATOSPHERIC OZONE LAYER. Paetzold, H. K. (Univ., Cologne). Pure Appl. Geophys.; 106-108: No. 5-7, 1308-1311(21 Aug 1972).

From symposium on atmospheric ozone; Arosa, Switzerland (21 Aug 1972).

For two sunspot cycles, the yearly means for the sunspot number R and the magnetic activity Ap are given. The dependence of the main stratospheric ozone layer from the sunspot number R is shown. It is seen that the variation of the total ozone amount measured from the ground may vary only by about 3% during a sunspot cycle. (auth)

19739 REDSHIFT OF SPECTRAL LINES OF SOLAR SPECTRUM. Kipper, A. Publ. Tartu. Astrofiz. Observ.; 41: 20-29 (1973).

The redshift of the spectral lines of the Sun can only partially be explained by the gravitational redshift. It was confirmed that the measured redshift, the so-called limb effect, cannot occur due to gravitational redshift. Tests are given for explaining the redshift by continuous energy loss. (WDM)

19740 MAXWELLIAN RELATIVE ENERGIES AND SOLAR NEUTRINOS. Clayton, D. D. (Rice Univ., Houston, TX). Nature (London); 249: No. 5453, 131(10 May 1974).

A suggestion that the deficiency of ^{8}B solar neutrinos may indicate a departure of the distribution of relative kinetic energies from the Maxwellian distribution is examined. (UK)

19741 TRANSFER OF POLARIZATION IN A STATISTICALLY NONHOMOGENEOUS COSMIC PLASMA. Erukhimov, L. M.; Kirsh, P. I. Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 12, 1783-1788(1973). (In Russian).

From the equation for wave dispersion in a continuously variable nonhomogeneous magneto-active plasma, an expression is derived which describes the polarization characteristics of waves of different frequency in the case of a weakly anisotropic medium with statistical nonhomogeneity. This expression is further developed for various special cases. From the expressions presented, the regular and statistical interaction of normal waves in a plasma can be written. (TTT)

19742 EFFECT OF RADIOWAVE DIFFRACTION ON NONHOMOGENEOUS INTERPLANETARY AND INTERSTELLAR PLASMA ON RESOLVING CAPABILITY OF INTERFEROMETERS WITH ULTRA-LONG BASES. Shishov, V. I. (Lebedev Inst. of Physics, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 12, 1796-1799(1973). (In Russian).

Conditions under which interferometer resolution is impossible are developed mathematically. (TTT)

19743 DIRECTION OF SOUND WAVES FROM LOCAL SOLAR SOURCES WITH CONSIDERATION OF EVOLUTION EFFECT. Grebinskii, A. S.; Korobchuk, O. V. (Leningrad State Univ.). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 12, 1842-1845(1973). (In Russian).

The relation of optical and radio characteristics of sunspots at different wavelengths and the change in flux density with wavelength were examined. Comparison of results obtained with published results indicated that the method used here in which the stage of evolution of the spots is considered, accounts for direction problems, which usual methods do not do. A model of the spots in the form of a spherical condensation is consistent with the results. (TTT)

19744 RELATION BETWEEN X RAYS AND SOUND WAVES OF ACTIVE REGIONS OF THE SUN FOR A HETEROGENEOUS MODEL. Grebinskii, A. S. (Leningrad State Univ.). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 12, 1835-1841(1973). (In Russian).

19745 DEPENDENCE OF POLARIZED RADIATION FROM LOCAL SOLAR SOURCES ON DEVELOPMENT STAGE OF THE ACTIVE REGION. Akhmedov, Sh. B.; Peterova, N. G. (Leningrad Branch of Special Astrophysics Observatory). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 12, 1830-1834(1973). (In Russian).

Changes in polarized radiation with development of the corresponding sunspots were followed using simultaneous observations of circular polarization of solar sound waves. With transition from small groups of sunspots to large, the ratio of the degree of polarization changed by almost an order of magnitude. With the small spots, the longer-wavelength radiation was more intense than was the shorter. The results are interpreted in terms of a magnetic retardation mechanism. (TTT)

Galaxies

Refer also to abstracts 19631, 19741, 19742, and 20168.

19746 SIMPLE MODEL OF THE GALAXY WITH A NEW DENSITY LAW. Saha, G. (Jadavpur Univ., Calcutta). Indian J. Pure Appl. Phys.; 11: No. 11, 791-794(Nov 1973).

A model of the Galaxy based on a new density law [$\rho = \rho_0 \sqrt{1-m^2}$] has been proposed. The potential and attraction in the plane of symmetry were calculated and the circular velocity is derived at different distances from the center. The volume and projected densities were deduced at different distances. The total mass ob-

tained in this model is comparable to that obtained in some other models, available in literature. (auth)

19747 SPECTRA OF MARKARYAN GALAXIES. VI. Arakelyan, M. A.; Dibai, E. A.; Esipov, V. F. (Byurakan Astrophysical Observatory, Moscow). Astrophysics (Engl. Transl.); 8: No. 2, 197-200(1972).

Translated from Astrofizika; 8: No. 3, 329-335(1972).

Results are given of spectral observations of 29 objects from the lists of galaxies with ultraviolet continuum. Emission lines were observed in the spectra of 25 objects. The presence of Seyfert characteristics in the spectrum of object No. 236 was confirmed. Object No. 376 can also be reliably included in this class. Although less clear, characteristics of the nuclei of Seyfert galaxies were also found in objects No. 382, 388, and 391. Of these, No. 388 is a dwarf formation with luminosity not greater than $M_{pg} = -14.5$ and diameter not greater than 400 ps. The results of spectral observations of galaxies with ultraviolet continuum are summarized. (auth)

19748 PRELIMINARY DATA ON THE OPTICAL VARIABILITY OF THE JET EMANATING FROM THE NUCLEUS OF NGC 4486 (M87). Pronik, V. I.; Shcherbakov, A. G. (Crimean Astrophysical Observatory, USSR). Astrophysics (Engl. Transl.); 8: No. 3, 201-204(1972).

Translated from Astrofizika; 8: No. 3, 337-342(1972).

Published photographs of NGC 4486 obtained by various observers at different times and also original photographs obtained with the 2.6-m telescope of the Crimean Observatory reveal a relative change in the brightnesses of the individual condensations of the NGC 4486 jet. (auth)

19749 ESTIMATES OF THE BRIGHTNESS OF SELECTED MARKARYAN GALAXIES. Arakelyan, M. A.; Dibai, E. A.; Lyutyi, B. M. Byurakan Astrophysical Observatory, Moscow). Astrophysics (Engl. Transl.); 8: No. 3, 280-281(1972).

During 1970-1972, the 125-cm and 60-cm reflectors of the Crimean Station of the Shternberg State Astronomical Institute were used to estimate the brightnesses in the UBV system of a number of objects from the lists of galaxies with ultraviolet continuum. An electrophotometer with photon counter was used. The observations were made by the differential method with respect to standard stars. The instrumental system was near UBV. The transparency coefficients were determined for each night. (WDM)

Cosmology

Refer also to abstract 20310.

19750 (N-73-32742) ALGEBRAICALLY SPECIAL SPACE-TIME IN RELATIVITY, BLACK HOLES, AND PULSAR MODELS. Adler, R. J.; Sheffield, C. (National Aeronautics and Space Administration, Moffett Field, Calif. (USA). Ames Research Center). Aug 1973. 107p. (NASA-TM-X-62298). NTIS $7.50.

The entire field of astronomy is in very rapid flux, and at the center of interest are problems relating to the very dense, rotating, neutron stars observed as pulsars, the hypothesized collapsed remains of stars known as black holes, and quasars. Degenerate metric form, or Kerr-Schild metric form, was used to study several problems related to intense gravitational fields. (auth) (STAR)

19751 (N-74-10785) ROLE OF ANTIMATTER IN BIG-BANG COSMOLOGY. Stecker, F. W. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Nov 1973. 13p. (NASA-TM-X-70512). NTIS $3.00.

Big-bang cosmology is discussed with reference to both its strong points and gaps. Characteristics of a spectral component of red shifted gamma radiation from cosmological matter-antimatter annihilation show a flattening of the gamma-ray spectrum in the vicinity of 1 MeV, an increased gamma-ray flux between 1 and 100 MeV, and a very steep spectrum between 50 and 135 MeV. This data fits well with the theoretical predictions in energy and intensity. (STAR)

19752 (SLAC-Trans-165) COSMOLOGICAL CONSEQUENCES OF THE SPONTANEOUS BREAKDOWN OF DISCRETE SYMMETRY. Zeldovich, Ya. B.; Kobzarev, I. Yu.; Okun, L. B. (AN SSSR, Moscow. Matematicheskij Inst.). Jun 1974. Translation by V. Baluni of Preprint No. 15. 10p. Dep. NTIS $4.00.

Recently field theoretical models with spontaneously broken symmetries have been used to construct unified theories of weak and electromagnetic interactions. In the framework of these models there have been attempts to understand in particular such phenomena as the breakdown of CP invariance. Possible astrophysical and cosmological implications of these models are discussed with the example of a simple model of CP invariance breaking. (WDM)

19753 f GRAVITY AND GRAVITATIONAL SINGULARITIES. Sivaram, C.; Sinha, K. P.; Lord, E. A. (Indian Inst. of Science, Bangalore). Nature (London); 249: No. 5458, 640-641(14 Jun 1974).

It was postulated (Trautman, Nature Phys. Sci. 242:7 (1973)) that the usual space-time singularity in classical cosmological models and in the gravitational collapse of massive objects could be avoided if intrinsic spin effects are incorporated into general relativity by adding torsion terms to the usual Einstein field equations (the Einstein-Cartan theory). The effect of taking f gravity into account in Trautman's model was investigated (Salam and others, Nature Phys. Sci. 244:82 (1973)), leading to profound charges in the numerical values of the parameters, and leading to the conclusion the spin-aligned hadronic matter will not collapse to densities higher than 10^{17} g/cm^3, which is only two or three orders of magnitude higher than that of nuclear matter. The perfect spin alignment necessary for these results, however, is difficult to realize. The authors suggest a possible way to avoid this difficulty. (UK)

19754 EQUATIONS OF MOTION IN THE GENERAL THEORY OF RELATIVITY IN THE SECOND POST-NEWTONIAN APPROXIMATION. Arak, V. Publ. Tartu. Astrofiz. Observ.; 41: 41-62 (1973). (In Russian).

Starting from the Einstein equations, a Fokker-type Lagrangian for the motion of a system of particles is derived in the second post-Newtonian approximation. (auth)

19755 BEHAVIOR OF THE DENSITY CONTRAST IN LOW-DENSITY REGIONS. Saar, E. Publ. Tartu. Astrofiz. Observ.; 41: 30-40(1973). (In Russian).

The process of gravitational condensation in the Friedmann cosmological models was studied. Taking into account the specific features of hydrodynamical motions in low-density regions, a simple equation was derived describing the time evolution of the density contrast, and its solution is given in the linear approximation. The results are of interest for checking cosmological models and theoretically estimating the total amount of matter in condensations. (auth)

19756 ABSORPTION OF RADIO WAVES IN COSMOLOGICAL SPACE. Kipper, A. Publ. Tartu. Astrofiz. Observ.; 40: 53-72 (1972).

An attempt is made to explain the so-called background radiation by the radiation coming from extremely distant cosmological objects and remaining after cosmological absorption. It is shown that observational data seem to support this hypothesis. (WDM)

19757 DUST-FILLED VISCOUS UNIVERSES. Heller, M. (Jagellonian Univ., Krakow); Suszycki, L. Acta Phys. Pol.; B 5: No. 3, 345-351(1974).

The Friedmann Equation with the bulk viscosity term (coefficient of bulk viscosity = const) is integrated for the dust-filled models. It appears that the introduction of dissipation removes the initial singularity provided it is allowed by the Hawking-Penrose Theorem. Many models obtained by this method, although analytically regular, possess regions with negative energy. (auth)

19758 ANISOTROPY OF CARRIER MASSES IN TENSOR GRAVITATIONAL THEORIES. Treder, H. J. (Zentralinstituts fuer Astrophysik, Potsdam, Ger.). Ann. Phys. (Leipzig); 29: No. 3, 233-250(Sep 1973). (In German).

According to the general theory of relativity an anisotropy of the space-like components of the matter-tensor generates an anisotropy of the three dimensional space metric in any noninertial reference system, i.e., in any non-freemoving laboratory. (WDM)

19759 POSSIBLE LINEAR FORM OF THE LORENTZ COVARIANT GRAVITATIONAL THEORY. Treder, H. J. (Zentralinstitut fuer Astrophysik, Potsdam, Ger.). Ann. Phys. (Leipzig); 31: No. 1, 1-17(1974). (In German).

Lorentz-covariant theories of gravitation which fulfill Einstein's weak principle of equivalence and which contain a pure Newtonian theory as an approximation are tensor theories with the linear approximative form $\Box g_{\mu\nu} = -\varkappa(\alpha T_{\mu\nu} + [1-\alpha]\,\eta_{\mu\nu} T)$ for the field equations. In the case of Einstein's strong principle of equivalence the exact field equations must be the general relativistic Einstein-equations (or the bimetrical Einstein-Rosen-equations). This follows from the dynamical equations and the Bianchi identity according to Jánossy and Treder. However, from Newton's axiom of reaction together with the weak principle of equiva-

lence results that the strong principle of equivalence must be valid for the linear approximation of the field equations with sources. Therefore, the linear approximation of all physically meaningful Lorentz-covariant theories of gravitation is given by the linearized Einstein-equations (with Hilbert-conditions): $\Box g_{\mu\nu} = -2\kappa(T_{\mu\nu} - \frac{1}{2}\eta_{\mu\nu}T)$, that is by the ansatz $\alpha = 2$. The main point of the argument is Laue's postulate of the self-consistency of perfect static systems of isolated gravitational masses. In the lowest order of approximation this self-consistency is only possible if the gravitational matter-tensor is identical with the special-relativistic energy-momentum-tensor $T_{\mu\nu}$. Laue's postulate is fulfilled exactly for the general relativistic field equations according to the theorems of Birkhoff, Tolman and Einstein and Pauli. (auth)

Planetary Phenomena

Refer also to abstracts 19582 and 19591.

19760 PHYSICS OF PLANETARY IONOSPHERES. Bauer, S. J. Physics and Chemistry in Space. Volume 6. New York; Springer-Verlag New York, Inc. (1973). 237p. $32.00.

The fundamental physical and chemical processes in an idealized planetary ionosphere are considered as a general abstraction, with actual planetary ionospheres representing special cases. After describing the structure of the neutral atmospheres (the barosphere, the thermosphere, and the exosphere) and noting the principal ionizing radiations responsible for the formation of planetary ionospheres, a detailed study is made of the thermal structure of these ionospheres and of the chemical processes and plasma-transport processes occurring in them. The features of equilibrium and realistic models of planetary ionospheres are discussed, and an attempt is made to determine the extent of these ionospheres. Considering the ionosphere as a plasma, a plasma kinetic approach is developed for determining the effects of interactions between individual particles and waves in this plasma. The use of remote-sensing radio techniques and direct measurement or in situ techniques is discussed. Finally, the observed properties of the ionospheres of the Earth, Mars, Venus, and Jupiter are reviewed. (IAA)

19761 CHANGES IN INTEGRAL RADIOWAVES OF MARS IN THE PERIOD BETWEEN RESISTANCES, 1971 AND 1973. Krotikov, V. D.; Shchuko, O. B. Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 12, 1811-1815(1973). (In Russian).

Measurements of subject changes are presented and are discussed mathematically. (TTT)

19762 PROBLEM OF ENERGY SOURCE IN THE EVOLUTION OF TERRESTRIAL MATERIALS. Hou, T. F.; Ou-Yang, T. Y.; Yu, C. S. Ti Chih Ko Hsueh; No. 2, 89-102(May 1973).

The types of natural nuclear events and the evolutionary stages of nuclear transitional energy in terrestrial materials are examined. Emphases are placed on the natural nuclear decay energy, the induced and spontaneous fission energy of heavy nuclei, and the evolutionary stages of nuclear transitional energy during the evolution of the earth. The melting and differentiation of the mantle materials, the development and distribution of the crustal mobile belts, and cycles and momentum of crustal movement are discussed, as well as their relations to the types of nuclear transitional energy and the time-dependent variation of energy. The nuclear transitional energy, which controls the evolutionary stages of the terrestrial material and their characteristics, is the main energy source during the evolution of the earth. (JPRS)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstracts 19622, 19674, and 19738.

19763 (N-73-32293) AURORAL BREMSSTRAHLUNG AT BALLOON ALTITUDES. Seltzer, S. M.; Berger, M. J.; Rosenberg, T. (National Aeronautics and Space Administration, Washington, D. C. (USA)). 1973. 28p. (NASA-SP-3081). NTIS $3.00.

Data from a Monte Carlo calculation of the transport of electrons and secondary bremmsstrahlung are presented in tabular and graphical form. These data describe bremsstrahlung flux spectra at various atmospheric depths between 30 g/sq cm and 15.0 g/sq cm caused by wide-area uniform precipitation into the atmosphere of electrons with energies between 30 and 2000 keV. The angular distribution of the incident electrons has been assumed to be isotropic over the downward hemisphere. A basic set of results is given for incident monoenergetic electron beams, which can be used to treat incident electron beams with any spectrum of interest. A comprehensive set of results in the form of differential and integral bremsstrahlung flux spectra has been obtained for the case of electron beams with exponential energy spectra, for e-folding energies between 5 and 200 keV. (auth) (STAR)

19764 (SLA-74-191) EXPANSION METHOD FOR CALCULATING DISPERSION OF ELECTROMAGNETIC PULSES PROPAGATING IN THE IONOSPHERE. Vittitoe, C. N. (Sandia Labs., Albuquerque, N. Mex. (USA)). Jun 1974. Contract AT(29-1)-789. 50p. Dep. NTIS $5.50.

An expansion method for calculating the effect of dispersion upon electromagnetic pulses propagating through the ionosphere is applied to a double-exponential pulse. It may, however, be applied to any incident pulse that can be represented by a Fourier series. The phase angle introduced by the transmission medium is expanded in a Taylor series, which is truncated after the second-order dispersion term. Unlike many treatments of ionospheric propagation, the large-dispersion approximation is not made. In some cases the dispersed-pulse durations are greater than the times between arrivals of the various frequency components. The components then interfere to form quite complicated waveforms. It is found that the high-frequency, low-dispersion components often add constructively to produce the maximum amplitude in the transmitted signal. Equations are presented for frequency-domain analysis of the signal, but results are given in the time domain. Appendixes outline a rapid method for calculation of the Fresnel integral and its auxiliary functions; present results for propagation of the double-exponential pulse through a series of atmospheric ionizations; and illustrate the contributions of individual frequency components, as well as the effect of correction factors to account for the possibility of low dispersion of some frequency components. (auth)

19765 GEOCORONA. Bertaux, J. L. (CNRS, Essonne, France). Rech. Spatial; 12: 14-18(1973). (In French).

The word "geocorona" is often used to designate the overall distribution of atomic hydrogen in the terrestrial atmosphere. It evokes, in fact, the exospheric part of this distribution where H is found in abundance, and then becomes the unique atmospheric constituent. The distribution of atomic hydrogen in the terrestrial atmosphere is discussed. It is their interaction with the solar radiation which makes it possible to detect the H atoms by optical methods. The geocorona is an intense source of diffused Lyman alpha radiation, and a much less intense source of Lyman beta and H alpha. Some experiments already carried out by the CNES are described. The French satellite D-2A Tournesol is practically devoted entirely to the problem of the geocorona. (IAA)

19766 PHARE EXPERIMENT: LYMAN AND GEOCORONAL EMISSIONS IN THE EQUATORIAL REGIONS. Millier, F. (CNRS, Essonne, France). Rech. Spatial; 12: 18-20(1973). (In French).

Launched on Sept. 14, 1972 by a Dauphin rocket probe from the Guiana base of Kourou, the PHARE experiment had two objectives. The first was measurement of the intensity of emission of the Lyman alpha line (1215, 664 A) of atomic hydrogen of the terrestrial atmosphere between 80 and 100 km. The second objective was measurement of the concentration of atomic hydrogen in the mesosphere. The rocket probe peaked at 103 km, and its movements of precession and of rotation made possible observations in all azimuthal directions making an angle of plus or minus 20 deg with the horizontal plane. The experiment has brought useful information on the mesosphere in giving the concentration of molecular oxygen and in showing the existence of an anisotropic Lyman alpha emission localized at some hundreds of kilometers to the southwest of Kourou. (IAA)

19767 EXPERIMENTS IN HIGH LATITUDE REGIONS. Reme, H. (Univ., Toulouse). Rech. Spatial; 12: 8-13(1973). (In French).

To determine the characteristics of auroral particles, three rockets were launched, one from Andoya, Norway, and two from Kiruna, Sweden. The first rocket probe was launched into a diffuse aurora characteristic of the recovery phase of a magnetospheric substorm. The second rocket probe crossed a structural aurora at the beginning of the expansion phase of a substorm. The third rocket probe crossed a highly fugitive aurora displacing itself toward the west. Measurements of the auroral X radiation are described, and particulars of rocket firings in the Antarctic are given. (IAA)

19768 THEORETICAL INVESTIGATION OF BANDED CHORUS. Nunn, D. (King's Coll., London). J. Plasma Phys.; 11: No. 2, 189-212(Apr 1974).

A computational study is presented of nonlinear resonant particle trajectories in wave fields consisting of an array of narrow-band waves of closely spaced frequencies and wavenumbers. It looks at two analogous systems, cyclotron resonance with a whistler wavefield and Landau resonance with an electrostatic wave field. It is found that the wave array is able to trap particles in much the same way as a single mode. Inhomogeneity plays a vital role by causing the energy of trapped particles to change. The nonlinear resonant particle current is such as to preserve the modal structure of the wave field, and it does not change the frequency of an individual mode. Power distribution amongst the modes is far from even. Most of the energy goes into the mode at one end of the array, depending on the direction of the inhomogeneity. Also, nonlinear resonant particle excitation of a broad band signal was found to cause spectral structuring to develop automatically. The theory was applied to one of Coroniti's FTRS analyses of banded chorus elements. The observed spectral behavior closely accorded with the computational results. The numbers involved fitted the theory very well, and strongly suggested that nonlinear cyclotron resonant particle excitation is the mechanism for banded chorus. (auth)

19769 OBLIQUELY PROPAGATING UNSTABLE WHISTLER WAVES: COMPUTER SIMULATION. Cuperman, S.; Sternlieb, A. (Colorado Univ., Boulder). J. Plasma Phys.; 11: No. 2, 175-188(Apr 1974).

Obliquely propagating unstable electron cyclotron electromagnetic (whistler) waves were studied with the aid of an especially designed computer simulation experiment. The plasma-wave system considered was homogeneous and infinite, and the plasma was taken to be a mixture of warm (bi-maxwellian) and cold populations. With no cold plasma, the rates of growth of the low k modes maximized for the case of parallel propagation ($\theta = 0°$) and decreased as θ increased; for higher k modes, the opposite occurred. Changing from k space to ω space the above results indicated that off-angle propagation tended to stabilize the low-frequency whistlers but to destabilize the higher-frequency ones. The results were consistent with linear predictions. In all cases, however, the total electromagnetic energy generated in the system decreased with increasing θ. When cold plasma was added to the system, the total generated electromagnetic energy could maximize for a non-zero propagation angle. (auth)

Magnetospheric Phenomena

Refer also to abstracts 19545–19548, 19694, and 19734.

19770 (CONF-730804-P2, pp 884-889) SURPLUS RADIATION AT 200 TO 300 km ABOVE THE EARTH. Dobrotin, N. A.; Kurnosova, L. V.; Logachev, V. I.; Razorenov, L. A.; Fradkin, M. I. (Lebedev Inst. of Physics, Moscow). 1973.

From 13th international cosmic ray conference; Denver, Colorado, USA (17 Aug 1973).

In 13th international cosmic ray conference. Vol. 2.

One observes so-called surplus radiation at altitudes of 200-300 km where the ordinary trapped radiation should not exist. The surplus radiation intensity surpasses the cosmic ray intensity several times. The results of flux measurements are given for protons with $E_p > 400$ MeV and for electrons with $E_e > 10$ MeV. (auth)

19771 LONGITUDINAL EFFECT IN THE RESPONSE OF TOTAL ELECTRON CONTENT TO MAGNETIC STORMS. Hearn, A. L. (Illinois Univ., Urbana). Nature (London); 249: No. 5453, 133-134(10 May 1974).

A longitudinal effect in the behavior of the storm time and the diurnal components of disturbed total electron contents is reported. (UK)

19772 VARIATION OF NIGHT AIRGLOW INTENSITIES IN DECEMBER 16–19, 1971 AT CHICHIJIMA (OGASAWARA IS.). Takechi, A. (Tokyo Univ.); Saito, B. I. Rep. Ionosphere Space Res. Jap.; 27: No. 3, 109-114(Sep 1973).

Low-latitude observations of the night airglow were made at Chichijima (Ogasawara Islands), geomagnetic latitude +17.1°, in three periods; October 14-25, December 15-24, 1971 and March 5-25, 1972, using an all-sky scanning photoelectric photometer. In the December period one particularly valuable set of observations was made when an abnormal enhancement was observed in the 6300 Å emission associated with the geomagnetic storm. The results for the 5577 Å and 6300 Å emissions in this period are summarized as follows: 1) Except at the time of enhancement, the time variations in the zenith intensity were quiet or gradual, and it is noted that the mean intensity of the 6300 Å was two or three times higher than those of the other periods and that of the 5577 Å was about half that of other periods. 2) Throughout the nights, clear intensifications appeared constantly in the southern sky possibly indicating the effects of the equatorial anomalies in the ionospheric F layer. 3) An unusual enhancement associated with the geomagnetic storm occurred around 11:00 UT on December 17/18. The intensity of the 6300 Å rapidly reached a peak value of about 350 rayleighs and the 5577 Å emission showed a parallel enhancement, whose peak value was about 120 rayleighs. 4) The area of enhancement of the 17/18 night covered almost all the sky and was undoubtedly linked with the area of southern intensifications cited above. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

19773 (BNL-tr-570) FORMATION OF NEGATIVE HYDROGEN AND HELIUM BEAMS BY CHARGE EXCHANGE IN SODIUM VAPOR. Dimov, G. I.; Roslyakov, G. V. (AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki). [nd]. Translation by S. J. Amoretty of IYAF-75-73. 13p. Dep. NTIS $4.00.

Experiments are described to obtain intense beams of H^-, D^-, and He^- ions with a sodium charge-exchange target. The yield and charge exchange are included in the discussion. (JFP)

19774 COMPTON ANALYSIS OF MOMENTUM DISTRIBUTIONS. Reed, W. A.; Eisenberger, P. (Bell Telephone Labs., Inc., Murray Hill, NJ). pp 271-289 of Charge Transfer: Electronic Structure of Alloys. Bennett, L. H. New York; Metallurgical Society of the American Inst. of Mining, Metallurgical, and Petroleum Engineers, Inc. (1974).

From symposium on charge transfer in alloys; Philadelphia, Pennsylvania, USA (30 May 1973). See CONF-730563-.

A review of Compton scattering is presented with some examples of how this technique is currently being used to study solids. (9 figures, 22 references) (auth)

19775 IONIC CHARGE STATES PRODUCED BY THE OSCILLATING ELECTRON ELECTROSTATIC ION SOURCE. Clark, R. B. (Manchester Univ., Eng.); Smith, A. G.; Fitch, R. K.; Ghander, A. M. J. Phys., E (London); 7: No. 7, 566-568(Jul 1974).

A magnetic analyzer was used to determine the charge states of the ions produced by the oscillating electron electrostatic ion source. With the appropriate gas the predominant ions were H_2^+, He^+, N^+, and Ar^{3+}, but higher charge states were seen and these increased with increasing source power. (auth)

19776 CONSISTENT THEORY OF SPUTTERING OF SOLID TARGETS BY ION BOMBARDMENT USING POWER POTENTIAL LAW. Kanaya, K. (Kogakuin Univ., Tokyo); Hojou, K.; Koga, K.; Toki, K. Jap. J. Appl. Phys.; 12: No. 9, 1297-1306(Sep 1973).

Starting from a simple atomic model by Lindhard giving a power potential between ions and atoms as $V(r) = z_1 z_2 e^2 a^{n-1}/r^n$, it was assumed that the first collision with a metal atom is of the weakly screened type (n = 2) or Rutherford type (n = 1) and that subsequent collisions of displaced atoms are similar to collisions of hard spheres (n = 5). On this basis, consistent expressions were obtained for the maximum yield S_{max} with the corresponding energy E_m for n = 2, and the universal curve of yield-energy, which on the number of atoms in the target materials per unit volume N, the effective atomic radius α and the displacement energy E_d. The results were in good agreement with experiments over the energy range from 50 eV to 500 keV. (auth)

19777 X-RAY PRODUCTION BY ION BOMBARDMENT. Hink, W. (Univ., Wuerzburg, Ger.). pp 523-540 of Proceedings of the Sixth International Conference on X-ray Optics and Microanalysis. Shinoda, G. (Ed.). Tokyo; Tokyo Univ. Press (1972).

From 6th international conference on x-ray optics and microanalysis; Osaka, Japan (5 Sep 1971).

The background of x-ray production by heavy charged particles is reviewed. The thin and thick target yield for the excitation of characteristic x-rays by proton bombardment are discussed and the experimental arrangements described. Theoretical evaluations of the inner shell ionization cross section in different approaches are compared with experimental data. Recent results on heavy ion-produced x-rays which exhibit production cross sections up to several orders of magnitude higher than those for protons of the same energy and cannot be explained by direct scattering theory are presented. A model based on level-crossing by which these "anomalous" x-ray yields is described. Examples of the use of ion produced x-rays as an analytical tool are given, such as in the determination of the implanted ion depth distribution in a semiconductor. (auth)

19778 LONG-RANGE POTENTIAL IN THE SCATTERING OF ATOMS FROM SURFACES. Beeby, J. L.; Thomas, E. G. (Univ. of Leicester, Eng.). J. Phys., C (London); 7: No. 12, 2157-2164 (21 Jun 1974).

By a simple extension of an earlier one-dimensional model (Beeby et al., J. Phys., C: Solid St. Phys.; 4: 1269(1971)) it is shown that, in general, the weak attractive tail in the interaction potential between an incident atom and a surface does not alter the qualitative results derived from the earlier model. In the particular case of a slowly moving incident atom which interacts strongly with the surface some account must be taken of the long-range part of the potential. It is also shown that correcting an error in the earlier analysis modifies the diagrams used with only a small change in the conclusions drawn. (auth)

19779 DEPENDENCE OF ENERGY DISTRIBUTION OF SCATTERED IONS ON PRIMARY ION ENERGY. Lukanova, L. I.; Mashkova, E. S.; Molchanov, V. A.; Pavlova, A. D. Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 6, 821(Dec 1973).

Translated from Zh. Tekh. Fiz.; 43: No. 6, 1297-1298(Jun 1973).

The character of the transition from the dome-shaped distributions of scattered ions to the peaked forms with decreasing energy of the bombarding ions is given. Energy distributions of helium ions scattered by copper are found. (JFP)

19780 ANGULAR DEFORMATION OF THE ENERGY SPECTRUM OF THE ION COMPONENT IN CATHODE SPUTTERING OF LIGHT METALS BY HEAVY IONS. Adylov, A. A.; Veksler, V. I.; Reznik, A. M. (Tashkent State Univ.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 6, 830-831(Dec 1973).

Translated from Zh. Tekh. Fiz.; 43: No. 6, 1306-1308(Jun 1973).

An experimental study is made of the deformation of the energy spectrum of the ion component in the cathode sputtering of light metals by Cs^+ ions for various angles between the momenta of the primary and sputtered ions. The parameter characterizing the angular deformation is found to be independent of the energy of the primary ions and to be the same for the ion-target systems studied, in agreement with the theory derived by Veksler. (auth)

Atomic and Molecular Properties

Refer also to abstracts 19801 and 20149.

19781 CHARACTER OF THE PAIR INTERACTION IN SOLID AND GASEOUS H_2. England, W. (Colorado State Univ., Fort Collins); Etters, R.; Raich, J.; Danilowicz, R. Phys. Rev. Lett.; 32: No. 14, 758-761(8 Apr 1973).

Existing theoretical H_2 pair potentials are investigated. A spherically symmetric potential is developed applicable to solid H_2. It yields a ground-state energy of -98.7°K (experimental values range from -93.5 to -101°K). Pressure-volume data are also in excellent agreement with experiment between 0 and 25 kbar. Second virial coefficients using this potential are consistently too low. When an anisotropic pair potential is used, agreement becomes very good. (auth)

19782 SINGLE-TRIPLET MIXING IN HELIUM AND ITS CONSEQUENCES IN ELECTRON EXCITATION EXPERIMENTS. Van Raan, A. F. J.; Heideman, H. G. M. (Bielefeld Univ., Ger.). J. Phys., B (London); 7: No. 7, L216-L220(11 May 1974).

The problem of singlet-triplet mixing in helium is discussed. Some obscurities in the existing formalism are removed and a new parameter—the mixing factor—is introduced, which is more convenient in the analysis of experimental work. (auth)

19783 LINE PROFILE FUNCTION FOR HYDROGENIC ATOMS. Sapar, A.; Kuusik, I. Publ. Tartu. Astrofiz. Observ.; 40: 143-161(1972).

Consideration is given to the hydrogenic atoms which owing to the energetic degeneracy of the states with regard to the orbital and magnetic quantum numbers have the undisturbed parabolic stark states which give rise to the linear stark effect. (WDM)

19784 FREQUENCY-DEPENDENT DAMPING CONSTANT OF QUASIELASTIC ELECTRON IMPACTS FOR HYDROGEN. Sapar, A. Publ. Tartu. Astrofiz. Observ.; 41: 113-118(1973).

The electron impact transitions between the initial and final states of a bounded electron with the coinciding principal quantum number and their influence on the damping constant are considered. (WDM)

19785 FADDEEV EQUATIONS FOR AN UNNATURAL-PARITY STATE. Banerjee, S. N. (Jadavpur Univ., Calcutta). Lett. Nuovo Cim.; 10: No. 12, 521-522(20 Jul 1974).

The eigenenergy of an excited state of the He atom (2^3 P$^-$-state) with odd parity, but degenerate in energy with respect to different values of the total angular momentum j (0,1,2), is calculated. The calculated result yields a value of -1.802 e^2/a_0 for the eigenenergy of the He (2^3 P$^-$). (JFP)

19786 MULTIPHOTON IONIZATION OF HYDROGEN IN THE MOMENTUM TRANSLATION APPROXIMATION. DeWitt, R. O. Washington, DC; American Univ. (1973). 104p. University Microfilms Order No. 74-13,719.

Thesis (Ph. D.).

A nonperturbative theory, the momentum translation method, is applied to multiphoton ionization of the hydrogen atom by an intense

electromagnetic field. Transition matrices are calculated for direct ionization by the simultaneous absorption of N photons from linearly and circularly polarized fields. Correction terms are calculated for cases when multiples of the photon energy nearly coincide with intermediate atomic levels leading to near resonance conditions. The correction terms are found to be not only very large, but to change the character of the direct transition results and reinforce the dominance of linear polarization over circular polarization. (Diss. Abstr. Int., B)

19787 PATH INTEGRALS IN INTENSE FIELD ELECTRODYNAMICS AND PHOTODETACHMENT OF H^- IN INTENSE ELECTROMAGNETIC FIELDS. Rahman, N. K. Washington, DC; American Univ. (1973). 72p. University Microfilms Order No. 74-13,724.

Thesis (Ph. D.).

Motivated by the Feynman formulation of quantum mechanics, a path integral technique is devised to produce corrections to the momentum translation approximation useful for treatment of multiphoton processes in intense field electrodynamics. Basic correction terms are produced, which turn out to be small corrections to the original theory. A bound-free transition problem is investigated with a technique which unifies all the angular momentum components in one analytic term. Specifically, the multiphoton electron detachment of H^- is studied, and theoretical differential and total cross sections are presented. (Diss. Abstr. Int., B)

19788 INNER SHELL IONIZATION BY RELATIVISTIC ELECTRONS. Das, J. N. (University Coll. of Science, Calcutta). J. Phys., B (London); 7: No. 8, 923-927(1 Jun 1974).

A systematic theoretical study of the inner shell ionization of atoms of various nuclear charges was made. The results were compared with some existing experimental data and with some predictions of other theories. (auth)

19789 AB INITIO CALCULATION OF THE NEON–NEON $^1\Sigma_g^+$ POTENTIAL AT INTERMEDIATE SEPARATIONS. Stevens, W. J. (Argonne National Lab., IL); Wahl, A. C.; Gardner, M. A.; Karo, A. M. J. Chem. Phys.; 60: No. 5, 2195-2196.

Some results are given of a series of ab initio calculations of well defined accuracy are reported for the neon–neon potential at intermediate separations. (JFP)

19790 X RAY SPECTROSCOPIC STUDY OF 4f HEAVY RARE EARTH METALS. Padalia, B. D. (Indian Inst. of Tech., Bombay); Tripathi, B. C.; Gupta, S. N.; Vijayavargiya, V. P. J. Phys., F (London); 4: No. 6, 938-946(Jun 1974).

The L absorption spectra of 4f heavy rare earth elements, ^{65}Tb to ^{69}Tm and ^{71}Lu, in the pure metallic state was investigated with a 40 cm curved mica crystal spectrograph of transmission type. Microphotometer records of L_2 and L_3 absorption edges taken at 25× magnification exhibit two distinct abrupt rises in absorption (L_2' and L_3' edges) except for ^{71}Lu. Wavelengths of L absorption edges of these metals were measured. A prominent absorption maximum (or so called "white line") was detected at the L_2 and L_3 edges. The peak position of the white line, its distance from the L edge position, and its full width at half maximum were reported. An attempt was made to estimate the position of 4f unoccupied levels and to interpret the observed spectral features in the light of available theoretical data on the rare earth metals in question. (auth)

19791 EXPERIMENTALLY-DETERMINED OSCILLATOR STRENGTHS FOR MOLECULAR HYDROGEN. III. Rotational Variation of Band Strength. Lewis, B. R. (Adelaide Univ.). J. Quant. Spectrosc. Radiative Transfer; 14: No. 8, 723-729(Aug 1974).

The first unambiguous absorption measurements which verify the dependence of band strength on the rotational quantum number are presented. A description is made of highly accurate measurements on the R_0R_1 doublet and the P_2 line of the (3,0) Lyman band of molecular hydrogen, and it is found that the rotational variation of band strength indicated by the results is consistent with the theoretical calculations within the experimental uncertainty. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstract 19891.

19792 OBSERVATION OF K-SERIES TRANSITIONS IN PIONIC AND MUONIC ^{3}He ATOMS. Sapp, B. O. Williamsburg, VA; College of William and Mary (1974). University Microfilms.

Thesis (Ph. D.).

The energies, widths, and relative yields of muonic and pionic K-series x rays in liquid ^{3}He were measured for the first time. As a result of the excess of protons over neutrons in this nucleus, the results afford an interesting test of theory. The muonic K_α ($2p \rightarrow 1s$) and K_β ($3p \rightarrow 1s$) transition energies were measured primarily as a test of the experimental technique, since they are accurately predicted theoretically. The pionic K_α and K_β transition energies were found to be $E_{K_\alpha}(^3He) = 10.695^{+0.005}_{-0.021}$ keV, $E_{K_\beta}(^3He) = 12.671^{+0.005}_{-0.033}$ keV. By comparing these results to the energies predicted from purely electromagnetic interactions the pionic 1s-state strong interaction shift was found to be -43^{+14}_{-11} eV. This result is compared with predictions based on a phenomenological optical model potential, and agreement is found for one set of published optical parameters. The natural widths of the μK_α, πK_α, and πK_β x-ray lines in ^{3}He were also determined. The muonic width is unobservably small, as expected, while the πK_α and πK_β widths indicate a natural broadening of the pionic 1s state of Γ_{1s} (^{3}He) = 89 ± 67 eV. (auth) (Diss. Abstr. Int., B)

19793 INVESTIGATION OF POSITRON TRAPPING IN INDIUM. Crisp, V. H. C.; Lock, D. G.; West, R. N. (East Anglia Univ., Eng.). J. Phys., F (London); 4: No. 6, 830-838(Jun 1974).

High precision measurements of positron lifetimes in indium were carried out at five temperatures in the range 83°K to 405°K. Constraint free analyses of the results clearly establish the multicomponent nature of the lifetime spectra and the fitness of the "no escape" models of positron defect trapping phenomena. The implications for positron studies of vacancy formation energy are discussed. (auth)

19794 POSITRON ANNIHILATION IN THE LIQUID ALKALI METALS. Mori, G. (Kyoto Univ.). J. Phys., F (London); 4: No. 6, 821-829(Jun 1974).

Positron annihilation in the liquid alkali metals at just above their melting points is theoretically studied, using a perturbation approach. The positron and electron momentum distributions including only the ionic density correlation were self-consistently calculated within a complex energy approximation. The calculated positron effective masses (m^{**}) were about 1.4 m(Li) ~ 1.6 m(Rb) (m: bare positron mass). The positron resolution functions including both the ionic correlation and Coulombic interactions were also calculated by taking the simplest self-energy diagram in the combined perturbation expansion into consideration. These effects barely give m^{**} larger than the above results. Using these resolution functions the angular correlation curves were calculated, and it was found that the result for liquid Na agrees well with the corresponding experimental curve over the full range of momentum within the error limits, but there are still some appreciable deviations between them for liquid Rb. (auth)

19795 INFLUENCE OF THE BOUNDARY CONDITIONS ON THE STATES OF A POSITRONIUM ATOM. Ul'pe, L. R.; Shokhor, L. D. (Leningrad Inst. of Electrical Engineering). Sov. Phys.-Solid States (Engl. Transl.); 15: No. 9, 1854-1855(Mar 1974).

Translated from Fiz. Tverd. Tela; 15: No. 9, 2785-2788(Sep 1973).

The energy levels of a positronium atom in a solid are described using the method proposed previously for a hydrogen atom located in a spherical impermeable force cavity. The positronium lifetime is also considered. (JFP)

Collision Phenomena

Refer also to abstract 19782.

19796 (INIS-mf-1305, pp 84-107) CHAPTER 9. ELECTRONIC EXCITATION TRANSFER COLLISIONS. A Discussion of the Present State-of-Knowledge and a Survey of Literature. Lijnse, P. L. (Rijksuniversiteit Utrecht). 12 Dec 1973.

A survey of literature was given dealing with quenching, excitation and multiplet-mixing collisions for alkali-atoms as well as some other atoms. The present state of experimental knowledge and theoretical understanding of these types of collision processes are described. (auth)

19797 (ORO-3798-54) COMPREHENSIVE REPORT OF OVERALL ACTIVITIES. Green, A. E. S. (Florida Univ., Gainesville (USA)). 1974. Contract AT(40-1)-3798. 42p. Dep. NTIS $5.25.

Research activities in the areas of atomic, molecular, and radiation physics are summarized. A list of publications is appended. One section of the report is abstracted separately. (JFP)

For an abstract of the section see: 19798.

19798 (ORO-3798-54, pp 5-34) THEORETICAL CALCULATIONS OF W(E) BASED UPON DETAILED ATOMIC CROSS SECTIONS. Green, A. E. S. 1974.

In Comprehensive report of overall activities.

Calculations of W(E), the eV per ion pair, using methodologies based upon detailed atomic collision cross sections (DACS) are reviewed. Emphasis is given to a continuous slowing down approximation (CSDA), based upon DACS. The results are in approximate accord with experiment and indicate that W depends significantly upon energy, particularly at lower energy. Two stochastic methods based upon the microscopic approach are also discussed, the discrete energy loss method, and a full Monte Carlo treatment. For the same input DACS these yield similar but slightly lower W(E) values and they also vary significantly with energy. (auth)

19799 MEASUREMENT ABSOLUTE IONIZATION CROSS SECTIONS FOR ELECTRON IMPACT. Schneider, N. (Univ., Kiel). J. Phys., D (London); 7: No. 8, L83-L86(21 May 1974).

Ionization cross sections for electron impact was measured with crossed electron and atom beams. Total numbers of particles are determined by the light emission of excited atoms. Absolute ionization cross sections may be obtained by using absolute excitation cross sections. If these are not known, they may be measured in the same apparatus. Putting aside the absolute value of the excitation cross sections, the ionization cross section can be obtained in the latter case without calibration of the photomultiplier. Preliminary results for Ca are in good agreement with calculations by Lotz (Z. Phys.; 216: 214-47(1968)). (auth)

19800 ENERGY SHIFTS AND RELATIVE INTENSITIES OF K X RAYS PRODUCED IN FAST HEAVY CHARGED PARTICLE COLLISIONS. Li, T. K. College Station, TX; Texas A and M Univ. (1973). 263p. University Microfilms Order No. 74-13,080.

Thesis (Ph. D.).

Current theories of inner-shell ionization in fast ion-atom collisions were reviewed and a simplified classical treatment for multiple inner-shell ionization by Coulomb excitation, based upon the binary encounter model, was developed. The probability of simultaneous K-plus-L-shell ionization in collisions between Ca, Ti, Fe, and Cu target atoms and fast deuterons, alpha particles, and carbon ions was investigated. The results show that the fraction of Kβ x-rays emitted in the presence of an L-shell vacancy decreases with increasing projectile velocity above a projectile to L-shell electron velocity ratio of 1, decreases with increasing target atomic number, and increases with projectile charge. The projectile velocity dependence is in fairly good agreement with the simplified classical multiple ionization model. Systematic measurements of the dependence of Kβ/Kα x-ray intensity ratios on target atomic number ($19 \leq Z \leq 47$), and on the projectile energy and charge were carried out. The results were compared with Hartree-Fock-Slater calculations of radiative transition probabilities and found to be consistent with the intensity ratios expected for atoms multiply ionized in the L- and M-shells. Using the information obtained on simultaneous K-plus-L-shell ionization, the energy dependence of the simultaneous M-shell ionization probability was deduced and found to be in good agreement with the simplified classical multiple ionization model. Fission fragments from the spontaneous fission of ^{252}Cf were used to study x-ray spectra for ion-atom collisions involving very heavy projectiles. Spectral measurements of K, Ni, and Br K x-rays and Au L x-rays were carried out and compared with spectra resulting from excitation by alpha particles and photons. The large energy shifts and relative intensity differences observed in the fission fragment excited spectra are similar in character to those observed in fast carbon ion bombardments. Multiple L- and M-shell vacancy configurations together with high ionic charge states are required to reproduce the measured x-ray energy shifts with HFS calculations. (Diss. Abstr. Int., B)

19801 ELECTRON IMPACT ON He, H^-, AND O_2 NEAR RESONANCES. Ton, T. D. New Haven; Yale Univ. (1973). 236p. University Microfilms Order No. 74-12,492.

Thesis (Ph. D.).

The behavior of e-He cross sections at the first inelastic threshold is expressed analytically with a one-level s-wave R-matrix without background. The R-matrix formalism is appropriate for the description of the short-range interaction that governs the electron-impact 2^3S He excitation because of spin considerations. Moreover the approximation used is the simplest which will reproduce the ^2S resonance just below threshold. Fitting the observed threshold cusp (step-down) in the elastic cross section and the nearly vertical onset of the inelastic cross section at the first threshold requires inclusion of the long range effect of the polarization of the atom on a slow outgoing electron which was scattered inelastically. The geometric structure of the H^{--} ion. A possible structure in the $(e + H^- \rightarrow H + 2e)$ cross section at ~11.3 eV, below two other resonances at 14.5 and 17.2 eV, is interpreted as arising from a compound state $(e + H^- \rightarrow H^{--})$ with a simple wave function based on a geometric configuration in which all three electrons are simultaneously attracted towards the proton. A similar wave function for He^- gives a minimum energy corresponding to an e-He impact energy of ~46 eV near the resonance observed by Crooks et al., at ~50 eV. The rotating compound state in e-O_2 collisions. As the lifetime of the O_2^- ion was found comparable to its rotational period, a rotating compound state is considered using a Kapur-Peierls formalism with allowance for the proper symmetries and couplings of O_2 ($^3\Sigma_g^-$, Hund's coupling case (b)) and O_2^- ($^2\pi_g$ coupling case (a)). With some approximations, the vibrational excitation cross section integrated over the scattering angle and collision energy is unchanged from that of a target with a fixed, yet randomly oriented, nuclear axis. (Diss. Abstr. Int., B)

19802 FIELD-THEORETIC APPROACH TO THE DETACHMENT OF H^- BY ELECTRON IMPACT. Roy, T.; Bhattacharyya, S. (Jadavpur Univ., Calcutta). Lett. Nuovo Cim.; 10: No. 12, 499-503(20 Jul 1974).

The cross section for detachment of H^- is recalculated in the lowest approximation, but from a field-theoretic viewpoint for a bound-state problem. (JFP)

19803 UNITARITY IN LOW ENERGY REARRANGEMENT COLLISIONS. Bottcher, C. (Manchester Univ., Eng.). J. Phys., B (London); 7: No. 7, L221-L222(11 May 1974).

A general formula for the T-matrix in the resonant scattering of electrons by molecules is given and an expression deduced for the total cross section out of a given initial state which differs from the simple "golden rule" formula. It is pointed out that the S-matrix is not exactly unitary if a local approximation is used for the imaginary part of the complex potential energy. (auth)

19804 ASYMPTOTICS OF THE CHARGE-EXCHANGE CROSS SECTION OF FAST PARTICLES IN ONE-ELECTRON ATOMS. Potapov, V. S. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 2, 147-155(1974). (In Russian).

The results of the calculation of the asymptotic expression for the total overcharge cross section of fast particles in the one-electron atom were reported. The dependence of the cross section on the quantum number characterizing the final bound state was found. Formulas were obtained for the total capture cross section. (tr-auth)

19805 PREDICTIONS OF MULTIPLE K- AND L-SHELL IONIZATION BY ALPHA-PARTICLE IMPACT ON ATOMS WITH Z = 10 TO 100. McGuire, J. H. (Goddard Space Flight Center, Greenbelt, MD). At. Data Nucl. Data Tables; 13: No. 5, 491-498 (May 1974).

The peaked binary-encounter approximation is used to compute cross sections for removing one or more electrons from K and L shells of atomic targets with Z = 10, 15, 20, 25, 30, 40, 60, 80, and 100 by bombardment with alpha particles. The cross sections, $\sigma_{1K,nL}$ and $\sigma_{2K,nL}$, are plotted over a range of alpha energies in the MeV region near the peaks of these cross sections. The relative magnitudes of the $\sigma_{1K,nL}$ and $\sigma_{2K,nL}$ cross sections are similar. Estimates of multiple-ionization cross sections for other projectiles may be determined in some instances by means of the z^2 scaling law for the ionization probability. (18 figures) (auth)

19806 SCATTERING OF CHARGED PARTICLES IN THE FIELD OF A MAGNETIC DIPOLE. Pavlenko, Yu. G.; Guminov, E. N. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 2, 235-238(1974). (In Russian).

The elastic scattering of randomly polarized electrons in the field of a magnetic dipole was examined. (JSR)

19807 THEORETICAL STUDY OF FAST ELECTRON-ATOMIC HYDROGEN SCATTERING. Baye, D.; Heenen, P. H. (Univ., Brussels). J. Phys., B (London); 7: No. 8, 928-937(1 Jun 1974).

The second order diagonalization method with a twenty states basis is used to study electron-atomic hydrogen scattering. The electron trajectory chosen makes the quantum Born approximation and the impact parameter Born approximation equivalent. Results for differential and total cross sections and for polarizations are presented and compared with experiments and other theoretical calculations. (auth)

19808 COLLISIONAL ELECTRON DETACHMENT FROM HYDROGEN ATOMS BETWEEN 22 AND 45 MeV. Acerbi, E.; Birattari, C.; Candoni, B.; Castiglioni, M.; Cutrupi, D.; Succi, C. (Univ., Milan). Lett. Nuovo Cim.; 10: No. 14, 598-602(3 Aug 1974).

The range of available data for electron stripping cross sections from hydrogen atoms for various gases is extended up to an energy of 45 MeV. (JFP)

19809 RESONANCES FOUND WHEN EXCITING POTASSIUM ATOM BY ELECTRON IMPACT. Postoi, E. N.; Aleksakhin, I. S.; Zapesochnii, I. P. (Uzhgorod State Univ., USSR). Ukr. Fiz. Zh. (Russ. Ed.); 19: No. 5, 773-775(May 1974). (In Russian).

Precision studies were performed by the method of intersecting monoenergetic electron and atom beams for the excitation functions of a potassium atom spectral transitions within the energy range from the threshold to 25 eV. A complex structure as resonances of all the excitation functions is found. The presence of peaks in transitions from ^{2}S- and ^{2}D-levels to the ionization potential E_i is explained by direct excitation of these levels, and the further course is determined by cascade transitions from the above P-levels. The peaks in the region of 18 to 21 eV are explained by both direct excitation of 3p-electron and formation of short-living states of a negative ion. Resonances detected within the $(1-2)E_i$ range might be of another nature. (auth)

19810 COUPLED CHANNEL OPERATORS AND REARRANGEMENT SCATTERING. I. Comparative Study of One-State S-Wave e-H Scattering. Kouri, D. K. (Max-Planck Institut fuer Stroemungsforschung, Goettingen, Ger.); Craigie, M.; Secrest, D. J. Chem. Phys.; 60: No. 5, 1851-1857(1 Mar 1974).

Equations are derived for the amplitude density functions for the channel T matrix for rearrangement scattering. These equations are applied to electron-hydrogen atom exchange scattering. A calculation is made in the one-state approximation in which only the 1S state of hydrogen is considered. This calculation is compared with an earlier calculation using an alternate definition of the channel T matrix and with a number of other more complete s-wave calculations. The new definition of the channel T matrix is shown to be superior to the earlier definition for numerical computation. The one-state result is surprisingly accurate when compared to essentially exact variational results. This exceptional accuracy with such a limited basis is attributed to the fact that the formalism explicitly includes both the direct and the rearrangement channel descriptions. (auth)

19811 CLOSE-COUPLING ELASTIC AND INELASTIC INTEGRAL AND DIFFERENTIAL CROSS SECTIONS FOR $Li^+ + H_2$ COLLISIONS. McGuire, P. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (F. R. Germany)). Chem. Phys.; 4: No. 2, 249-258(May 1974).

The quantum mechanical close-coupling formalism is applied to the study of elastic and rotationally inelastic $Li^+ + H_2$ collisions making use of the Kutzelnigg-Staemmler-Hoheisel potential energy surface. Integral and differential cross sections for $j = 0 \rightarrow 0$ and $j = 0 \rightarrow 2$ are obtained in the collision energy range 0.2 to 0.9 eV and for $j = 1 \rightarrow 1$ and $j = 1 \rightarrow 3$ at 0.6 eV. A rainbow structure is observed in both the elastic and inelastic angular distributions and a quenching of the fast oscillations is found in the cross sections for $j = 1$ initially compared to the case $j = 0$ initially. At 0.6 eV the calculated quantum mechanical angular distributions are compared to those from a classical trajectory calculation using the same surface and to the experimental ones. The dynamics of rotational excitation in the $Li^+ + H_2$ system is contrasted to rotational excitation in systems for which the atom-diatom interaction is predominantly repulsive. (auth)

19812 THE TOTAL COLLISION CROSS SECTION IN THE SUDDEN APPROXIMATION FOR ANGULAR DEPENDENT POTENTIALS. Kuypers, J. W.; Reuss, J. (Katholieke Universiteit Nijmegen (Netherlands). Fysisch Lab.). Chem. Phys.; 4: No. 2, 277-283(May 1974).

In the sudden approximation, the influence of the angular dependent part of the intermolecular potential on the total collision cross section is investigated, for homonuclear diatom-atom collisions. Special attention is given to quenching of the glory amplitude for the orientation dependent part of the total collision cross section. (auth)

19813 INFLUENCE OF THE DIFFERENTIAL CROSS SECTION ON THE TIME OF FLIGHT SPECTRA OF METASTABLE HELIUM ATOMS PRODUCED BY ELECTRON IMPACT. Heppner, R. A. Ann Arbor, MI; University of Michigan (1973). 121p. University Microfilms Order No. 74-15,746.

Thesis (Ph. D.).

A beam of ground state helium atoms having a Maxwellian velocity distribution collides at right angles with a pulsed beam of electrons, and some of the atoms are excited to the metastable 2^3S_1 and 2^1S_0 metastable states. The velocity distributions of the outgoing metastable atoms are examined with a time-of-flight technique as a function of observation angle and incoming electron energy. Particular attention is given to the time-of-flight distributions obtained with electrons that have energies within 1.2eV of the 2^3S_1 excitation threshold. The shapes of the experimental distributions were found to depend very strongly on the resonances and interferences which occur in the differential cross section near the excitation threshold. The kinematic theory of the inelastic collision developed by Pearl is used together with values for the differential cross section obtained from the electron scattering experiments of Ehrhardt and his collaborators to calculate time-of-flight spectra that are compared to the results of the present experiment. Over the limited range (10 to 90°) for which the electron scattering data is available, good agreement between calculated and experimental distributions is found. Time of flight distributions calculated using the theoretical values of the differential cross section of Burke, Copper, and Ormonde, while qualitatively similar to the experimental distributions, show discrepancies which are probably attributable to approximations made in the theory for the cross section. (Diss. Abstr. Int., B)

19814 THEORETICAL STUDY OF FAST ELECTRON-HELIUM SCATTERING. Baye, D.; Heenen, P. H. (Univ., Brussels). J. Phys., B (London); 7: No. 8, 938-949(1 Jun 1974).

The second order diagonalization method with a twenty-two states basis (1^1S to 5^1D) is used to study electron-helium scattering. The differential cross sections for the excitation of the $n = 2$ levels reproduce fairly well the experimental data up to large angles (60° or more) at energies above 50 eV. The total cross sections for the 1^1S-n^1S and 1^1S-n^1D transitions ($n = 3, 4, 5$) are also in good agreement with experiment and improve greatly the first and second order Born results. The agreement between the 1^1S-n^1P cross sections and experiment is satisfactory only above 150 eV. The polarization of the 3^1P-2^1S and 3^1D-2^1P lines are also calculated and are in relatively good agreement with the experimental data. (auth)

19815 GLAUBER APPROXIMATION AND EVALUATION OF IONIZATION CROSS SECTION. Tsuji, A.; Miyamoto, A.; Narumi, H. (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto); 50: No. 1, 338-340(Jul 1973).

The validity and applicability of the Glauber approximation to the ionization of a hydrogen atom by electron impact is examined. The total and differential cross sections are considered. (JFP)

19816 SLOW COLLISIONS OF Li^+ IONS WITH He AND Ne ATOMS. Latypov, Z. Z.; Shaporenko, A. A. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 18: No. 6, 824-826(Dec 1973).

Translated from Zh. Tekh. Fiz.; 43: No. 6, 1300-1303(Jun 1973).

Experimental values of the total effective cross sections for the formation of He^+ and Ne^+ in collisions of Li^+ ions with helium and neon atoms in the energy range below 650 eV are discussed. (JFP)

19817 PROGRESS IN MOLECULAR BEAM STUDIES IN KYOTO UNIVERSITY. I. Kodera, K. (Kyoto Univ.). Shitsuryo Bunseki; 21: No. 2, 117-126(Jun 1973).

A review on the molecular beam studies performed in the Laboratory of Inorganic Chemistry, Kyoto University is given. N. Sasaki noticed that molecular beam would be a powerful method to study elementary process in chemical reaction. A pioneering work planned by Jono was to carry out crossed beam experiment in order to study the reaction of alkali atoms with halogen molecules. At present, the crossed beam method is the most powerful means to study chemical reactions. One of the aims of the studies in Sasaki's Laboratory was to reexamine the result of Polanyi's study on the reaction of alkali atoms and halogen molecules by diffusion flame method. The Polanyi's result suggested that the reaction between alkali atoms and halogen molecules proceeded with anomalously large effective diameter. The result by the Sasaki group was nearly the same as the reaction radius estimated as the sum of the radii of reacting atoms and molecules. Direct measurement of the absolute radii of collision between sodium atoms and reactive or nonreactive molecules was carried out to see the difference between them. The result revealed that even for the nonreactive collision, the collision was larger than the sum of gas kinetic values, and the effect of resolution was large. Another field of studies was the study on halogen molecule decomposition. The molecular beam was utilized to prove the direct decomposition of iodine molecules. The result agreed fairly well with calculation, and it was ascertained that the iodine molecules decomposed directly within 10^{-4} sec after the absorption of light without colliding with other molecules or walls. The detection of the molecular beam was also investigated. (auth)

19818 ABSOLUTE CROSS SECTIONS FOR EXCITATION OF THE 4^3S, 3^3P, AND 4^3D LEVELS OF HELIUM BY ELECTRON IMPACT. Measurements at Very Low Target-Gas Pressures. van Raan, A. F. J.; Moll, P. G.; van Eck, J. (Univ., Utrecht). J. Phys., B (London); 7: No. 8, 950-965(1 Jun 1974).

Total cross sections for electron-impact excitation of helium to the 4^3S, 3^3P, and 4^3D-levels were determined. From spectral line-intensity measurements cross sections were determined as a function of electron-impact energy E_{el} (100 to 1000 eV) in the helium pressure region from 3×10^{-5} to 3×10^{-3} torr. In the evaluation of the excitation cross sections polarization of the emitted radiation and cascade is taken into account. Special attention is paid to cascade from directly excited nF-levels which do not have well defined multiplicities. Pulse-counting techniques and automatic data-handling were necessary in order to

measure the very low light-intensities with reasonable statistics. Only cross sections measured at the lowest target-gas pressures were used to evaluate excitation cross sections. The resulting excitation functions which may be attributed to exchange excitation show the following energy dependences for $E_{el} > 100$ eV without (between parentheses with) cascade corrections: 4^3S, $E_{el}^{-2.50}(E_{el}^{-2.46})$; 3^3P, $E_{el}^{-2.85}(E_{el}^{-2.90})$; 4^3D, $E_{el}^{-2.80}(E_{el}^{-2.75})$. As far as the energy dependences are concerned, the experimental cross sections for 3^3P- and 4^3D-excitation are close to Ochkur's prediction (Soviet Phys., JETP; 18: 503-13(1964)), for the 4^3S excitation the agreement is less. The experimental absolute cross sections for 4^3D excitation are about an order of magnitude larger than those predicted by Ochkur. This work shows good agreement with experimental work of Anderson et al. (Phys. Rev.; A8: 810-15(1973)). (auth)

Atomic Theory

Refer also to abstract 20265.

19819 SYSTEMATIC IMPROVEMENT OF THE DENSITY MATRIX FOR A THOMAS-FERMI MODEL. Chan, S. F. New York; New York Univ. (1973). 74p. University Microfilms Order No. 74-13,312.

Thesis (Ph. D.).

The problem of a systematic improvement of the density matrix for a Thomas-Fermi model is studied. A brief review of the connection between Hartree-Fock and Thomas-Fermi model is given. The ad-hoc and systematic quantum corrections for Thomas-Fermi model are also briefly discussed. The generalized phase space density is written in a form that it would be suitable for an approximation scheme. After presenting a detailed computational technique for the exact density function of harmonic oscillator one returns to the generalized density function on which an approximation scheme is carried out. It involves a comparison potential U(x) and a weight function R(x). A 3-dimensional self-consistent equation which provides the relation of R(x) and U(x) is obtained. A similar 1-dimensional self-consistent equation is also given. The harmonic oscillator is discussed as a prototype for the problem; the analytic behavior of $\tilde{R}(k)$ is explored. (Diss. Abstr. Int., B)

19820 ATOM AND MOLECULE. Ursu, I. (Institutul de Fizica Atomica, Bucharest). pp 39-70 of Energia Atomica. Bucharest; Editura Stiintifica (1973). (In Rumanian).

The atomic structure and models, the quantum theory of the atom, are presented and the possibility to release chemical energy is explained. Rutherford's atomic model, the old Bohr-Sommerfeld quantum theory, the complex structure of the atoms and their periodicity, the molecule structure and chemical energy and properties are also presented. (AV)

19821 NATURAL APPROACH TO THE THEORY OF THE RADIATIVE CORRECTIONS TO ATOMIC LEVELS. Tzara, C. (CEN de Saclay, Gif-sur-Yvette, France). Nuovo Cim.; 22B: No. 2, 215-236(11 Aug 1974).

The problem of the shifts of the energy levels of nonrelativistic system interacting with a quantized field is investigated with the help of secular equations. The integral form of the secular equation in an extension of the Brillouin-Wigner-Kramers perturbation expansion. The Rayleigh-Schroedinger series is found as a limit valid for a small enough cutoff energy. Applications are made to the Lamb effect and the anomalous magnetic moment. (auth)

19822 ATOMIC LEVEL SPLITTING BY EXTERNAL FIELDS. Basano, L.; Cenni, R. (Univ., Genoa). Nuovo Cim.; 22B: No. 2, 261-272(11 Aug 1974).

An explanation is presented based on the properties of the Racah operators and the Wigner coefficients, of a set of rules which have been recently proposed for the solution of the quantitative problem of the splitting of a degenerate level. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

19823 SELF-SIMILAR PROBLEMS OF THE MAGNETOHYDRODYNAMICS OF NON-NEWTONIAN LIQUIDS. Martinson, L. K. Magn. Gidrodin.; No. 1, 148-150(1974). (In Russian).

A number of self-similar problem solutions are found on the displacement MHD-flow of a non-Newtonian fluid obeying a power rheological law on blowing in the non-Newtonian fluid through a nonconducting disk lying on the fluid. These solutions have the form of displacement waves whose fronts propagate with a velocity of medium movement in the direction towards that in which the fluid is blown in. (SJR)

19824 UNSTEADY MHD-FLOW PAST A POROUS PLATE WITH THE INDUCED MAGNETIC FIELD FROM HEAT TRANSFER BEING TAKEN INTO ACCOUNT. Megakhed, A. A. Magn. Gidrodin.; No. 1, 64-69(1974). (In Russian).

Consideration is given to the problem of unsteady flow around a porous plate by an electrically-conducting, viscous, incompressible liquid with the induced magnetic field and heat transfer being taken into account. An exact solution is obtained for the flow velocity and induced magnetic field at constant pump off and a magnetic Prandtl number equal to one, when the velocity of free flow is a function of time, and the possibility of this solution is shown only at an Al'fven velocity less than the pump off rate. In the case where the velocity of free flow is constant or is a periodic function of time, the solution is obtained in explicit form. Also a solution of the nonstationary equation for the influx of heat is found with the dissipative energy because of viscosity and joule heat being taken into account. In this case exact solutions are obtained for the temperature field, where a) heat transfer involving the plate is absent, and b) the temperature of the plate is a given function of time. (SJR)

19825 NON-STATIONARY MAGNETOHYDRODYNAMIC ROTATION OF VISCO-PLASTIC MEDIA IN NONHOMOGENEOUS MAGNETIC FIELD. Kosachevskaya, E. A. Mekh. Tverd. Tela; No. 2, 110-113(1970). (In Russian).

The rotation of a conducting visco-plastic medium caused by the unsteady boundary disturbance in the presence of crossed electrical and magnetic fields was examined. The approximation method developed by M. E. Shvets for the hydrodynamics of boundary layers was used for the solution of the problem. The stress distribution was found and an equation for the determination of the boundary of solids was introduced. (tr-auth)

19826 EXPERIMENTAL STUDY OF THE PLASMA FLOW IN DISC MHD CHANNELS UNDER CONDITIONS OF SPONTANEOUS FORMATION OF CURRENT LAYERS. Kerkis, A. Yu.; Sokolov, V. S.; Trynkina, N. A.; Fomichev, V. P. Zh. Prikl. Mekh. Tekh. Fiz.; No. 3, 31-37(1974). (In Russian).

The results of the experimental study of the plasma flow in a disc channel under conditions of strong hydromagnetic interaction were reported. It was shown that if at any place of the flow for a Reynolds magnetic number the condition $Re_m H_\delta^2 / 8\pi P \geq 0.2$ is fulfilled, then at that site a current layer, characterized by a high density of the electric current and high conductivity and temperature, appears. The formation of the current layer leads to a strong local retardation of the flow, the appearance of collision waves, and a series of other nonlinear hydromagnetic phenomena. The experimental results agreed with previously published theoretical studies. (tr-auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract 19864.

19827 (COO-1545-144(Pt.1-2)) HIGH ENERGY PHYSICS STUDIES. Progress Report. Part I. Experimental Program. Part II. Theoretical Program. (Ohio State Univ., Columbus (USA)). 1974. Contract AT(11-1)-1545. 47p. Dep. NTIS $5.50.

Experimental and theoretical research in high energy physics is summarized. A list of publications is included. (JFP)

19828 LIFE TIME OF X-PARTICLES FOUND BY NIU ET AL. Tasaka, S.; Yamamoto, Y. (Konan Univ., Kobe, Japan). Progr. Theor. Phys. (Kyoto); 50: No. 6, 1879-1893(Dec 1973).

Out of 44 jet showers observed by the Bristol-Bombay Group to have originated in the producing layer of their balloon-borne emulsion chamber (1961), eight have one or two cascade shower cores each of which is emitted within an angle smaller than those of the remaining γ-rays by a factor of ½ with an energy greater than those of the latter by a factor of 3. Although, in each event, a quantity of its energy divided by its emission angle excels those of the remaining γ-rays at least by a factor of 20. If one assumes that every highest energy γ-ray in these events is a decay product of π^0-meson, one can show that it is very probable that these eight groups of cores have originated from the decay π^0 of the X-particles found recently by Niu et al. The lifetime τ_0 of the X-particles is then estimated to be $1.5 < \tau_0/(10^{-13}\ \text{sec}) < 100$ and $2.6 < \tau_0/(10^{-13}\ \text{sec}) < 175$ for the two typical decay modes $X \rightarrow \pi + \pi^0$ and $X \rightarrow \Sigma + \pi^0$, respectively. The estimated values are rather long compared with those reported by Niu et al., but are consistent with the theoretical estimation by Ogawa et al. (auth)

Electromagnetic

Refer also to abstract 20007.

19829 (KHFTI-73-9, pp 43-45) π-MESON PHOTOPRODUCTION ON THE NUCLEUS ^{12}C WITH PROTON EMISSION. Glavanakov, I. V.; Kryshkin, V. I.; Stibunov, V. N. (Tomsk Polytechnic Inst., USSR). 1973. (In Russian).

The photoproduction of π mesons in reactions of the type $\gamma + A \rightarrow A' + p + \pi$ was studied. The ratio of the yields of π^0 and π^- was measured as a function of the maximum energy of the bremsstrahlung. The experimental data on the photoproduction cross section of the mesons were used to calculate the ratios of the radius of the spatial distributions of the protons and neutrons in the nucleus. The analysis results showed that the radius of proton and neutron distributions are equal with a precision of ± 0.3 Fermi. (tr-auth)

19830 ELASTIC AND INELASTIC ELECTRON-PROTON SCATTERING. Allton, E. A. Stanford, CA; Stanford University (1973). 146p. University Microfilms Order No. 74-6440.

Thesis (Ph. D.).

The first experimental attempt to measure the differential cross section for the production of single pions in electron-proton scattering near the first pion-nucleon resonance is described. An experiment in which the radiative tail from elastic electron-proton scattering is followed from the "peak" down to a secondary energy permitting single pion production at a center of momentum energy of 1100 MeV is presented. As far as we know, this is the first threshold measurement of the pion electroproduction cross section, but the error, predominantly statistical, is large because of the subtraction of the large bremsstrahlung cross section. What we believe to be the first successful extension of Schiff's peaking approximation to the case of the recoiling target is presented. The text of an article to be submitted for publication is given in which two well known formulas for the radiative correction to elastic electron-proton scattering are compared analytically and numerically. One of these is the "T-formula," due to Y. S. Tsai, and the other, the "MY-formula." (Diss. Abstr. Int., B)

19831 ANALYSIS OF TWO MESONS MAKING DELAYED DECAY IN A T-STAR. Hoshino, K. (Nagoya Univ., Japan). Uchusen Kenkyu; 17: No. 4, 484-490(Feb 1973). (In Japanese).

From symposium on charged particles and cosmic radiation; Hamamatsu, Japan (Dec 1971).

Interpretation on the report concerning π^0 mesons having the mean-life of 10^{-4} sec in a jet shower is described. An apparatus for measurement is an emulsion chamber consisting of 6 in. × 4 in. emulsion plates and brass plates. This emulsion chamber was exposed for 6 hours on a balloon. An observed T star is a jet shower produced in a brass plate above the emulsion plate No. 8. Thirty-six minimum ionization tracks were observed in the plate No. 8. The incident energy was estimated to be 1.6-26 TeV ($E_{p=0.5}$ = 6.5 TeV). Also several cascade showers produced by the gamma-ray due to $\pi^0 \rightarrow 2\gamma$ decay were observed. The total energy of these π^0's is about 1.9 TeV. Two cascade showers which formed very high energy double core were found. It is considered that these showers are the decay of π^0s. The mean life of these π^0's was estimated to be 1×10^{-4} sec. Reinvestigation of these delayed π^0s was made. When it was assumed that two π^0s were generated from one parent particle, the mass M_{X^0} and life τ_{X^0} of the parent particle were estimated as 2.56 GeV and 3.2×10^{-14} sec, respectively. When it was assumed that two π^0s were produced from respective parent particles, lower and upper limits of life were obtained. It is necessary to make more precise measurements by using the original plate to obtain exact conclusions, however, it may be impossible because the measurement had been made 22 years ago. The present study suggests the possibility that the event may be the same phenomenon as that observed by Niu et al., and may be an example of the pair production of X particle. (auth)

Weak

19832 DETERMINATION OF K_{l3} FORM FACTORS FROM MEASUREMENTS OF DECAY CORRELATIONS AND MUON POLARIZATIONS. Merlan, S. (Yale Univ., New Haven); Kasha, H.; Wanderer, P. J.; Adair, R. K.; Ankenbrandt, C. M.; Larsen, R. C.; Leipuner, L. B.; Smith, L. W.; Stefanski, R.; Shively, F. T. Phys. Rev., D; 9: No. 1, 107-119(1 Jan 1974).

Wire spark planes and scintillation counters were used in an experiment designed to measure the decay correlations among the products of the decay of stopped K^+ mesons to a muon, a neutrino, and a pion, and to measure the polarization of the muon. The results determined the value of the form factor ratio to be $\xi(0) = -0.57 \pm 0.24$. The momentum dependence of the f_+ form factor was defined by our measured value of $\lambda_+ = 0.027 \pm 0.019$ (taking $\lambda_- = 0$). From the analysis of the muon polarization, taking the values for λ_+ and λ_- found for the decay correlation analysis, the form factor ratio was measured to be $\xi(0) = -0.64 \pm 0.27$. (auth)

Strong (Baryon-induced)

Refer also to abstracts 20014-20016.

19833 (COO-2009-72) POLARIZATION IN PROTON-PROTON SCATTERING AT 5.15, 7.0, AND 12.33 GeV/c. Abshire, G. W.; Ankenbrandt, C. M.; Crittenden, R. R.; Curtis, D. B.; Heinz, R. M.; Hinotani, K.; Neal, H. A.; Petri, H. R.; Rust, D. R. (Indiana Univ., Bloomington (USA). Dept. of Physics). Jan 1974. Contract AT(11-1)-2009. 104p. Dep. NTIS $8.25.

The results of an experiment to measure the polarization in large angle proton-proton elastic scattering are presented. This experiment, performed at Argonne National Laboratory, represents the first high statistics proton-proton polarization measurements for $|t|$ values greater than 2.5 $(GeV/c)^2$. Using the arguments of Wolfenstein, it is shown that the proton-proton system is completely specified by five complex amplitudes. The polarization is represented as the product of the helicity amplitudes of Goldberger. Since the polarization is the product of amplitudes, it is very sensitive to the structure of the amplitudes. Thus, these measurements provide meaningful constraints on the amplitudes over a large range of t. A polarized target consisting of a liquid ^4He cooled ethylene glycol target in a 25 kG magnetic field produced the polarized protons. The two final state protons were detected in a two-arm multiwire proportional chamber spectrometer. Each arm determined the momentum of one of the protons with a resolution of ±5% and the time-of-flight within .7 ns. The momentum, time-of-flight, and scattering angle of each proton was used to determine which events were elastic. The 5.15 GeV/c polarization measurements covered from $t = -.54$ $(GeV/c)^2$ to $t = 4.03$ $(GeV/c)^2$. There is a minimum at $t = -.7$ $(GeV/c)^2$ followed by a maximum of .22 at $t = -1.8$ $(GeV/c)^2$. The polarization then monotonically decreases to 0.0 at $t = -4.03$ $(GeV/c)^2$. The polarization from $t = -.58$ to $t = -5.25$ $(GeV/c)^2$

was measured for 7.0 GeV/c. From a minimum at t = −.8 (GeV/c)², the polarization rises to a maximum of .20 at t = −1.7 (GeV/c)². From the starting point of t = −1.53 (GeV/c)² the polarization rises to a maximum of .20 at t = −1.7 (GeV/c)², then drops to a minimum at t = −2.3 (GeV/c)². There follows another maximum at t = −2.9 (GeV/c)², then another minimum at t = −4.6 (GeV/c)². The polarization is still rising for the last point measured at t = −6.2 (GeV/c)². The results are discussed in terms of four models. Two of these are optical models; one was proposed by Durand and Lipes, the other by Chu and Hendry. The other two models are the Regge pole model and the parton model. Fits to the data were done using the first three models; the optical model of Chu and Hendry best described the structure in the data. (auth)

19834 KAON−PION FINAL STATES IN $\bar{p}n$ INTERACTIONS AT 3.5 BeV/c. Simonangeli, L. J. Athens, OH; Ohio Univ. (1973). 141p. University Microfilms Order No. 74-13,144.

Thesis (Ph. D.).

Strange-particle production in $\bar{p}n$ interactions at a center-of-mass energy of 2.9 GeV was investigated. Results are presented for kaon-pion reactions having four or more bodies in the final state. The results include a comparison of spectator distributions with the simple impulse model assuming a Hulthén wave function, a discussion of effective-mass and pertinent particle production distributions, and cross sections. Most successful fits were to the 5-body final states $K^-\pi^-\pi^-K^+\pi^+(p_{sp})$ and $K^+\pi^+\pi^-K^0_V(p_{sp})\pi^0$. The cross section for the former channel is ~95 μb and for $K^+\pi^+\pi^-K^0_S(p_{sp})\pi^0$ ~ 110 μb. Spectator distributions for highly constrained final states (4c at the main vertex) are in good agreement with the simple inpulse model and Hulthén distribution. But those for lesser constrained reactions (1c at the main vertex) are not; in particular, when the spectator is not directly observed, the fitted momentum is essentially the same as the starting value and polar angular distributions show strong alignment with the beam direction. The distributions of the polar production angle in the $\bar{p}n$ center-of-mass system for the pions are symmetric about 0° and, thus, consistent with G-P predictions. On the other hand, similar distributions for the kaons are quite different. In particular, in 4- and 5-body final states, kaons prefer the beam direction, whereas antikaons prefer the neutron direction. At six bodies in the final state, however, these tendencies are no longer prevalent and the distributions "appear" to become isotropic. In addition, the corresponding center-of-mass momentum distributions of the kaons and pions are adequately represented by phase space. $K^*(890)$ is substantially produced in 4-body final states and decreases rapidly with multiplicity; none is present in 7-body reactions. There is relatively little $\rho(765)$, ($K_N(1440) \rightarrow K\pi$), $\omega(784)$, or $\phi(1019)$ present in our data. Furthermore, there is no overwhelming evidence supporting any effects in the $(K\pi\pi)$, $(K\bar{K}\pi)$, and threshold $(K\bar{K})$ systems. However, there are mild indications of a broad enhancement in the $K\bar{K}$ system up to (1300 ± 50) MeV. Continuing along these lines, 7-body reactions have unexplained effects at 1400 MeV in the $(K\bar{K}\pi)^0$ system and at ~1120 MeV in both the $|I_z| = \frac{1}{2}$ and $|I_z| = \frac{3}{2}$ $(K\pi\pi)$ systems. (Diss. Abstr. Int., B)

19835 POLARIZATION TRANSFER IN PROTON−DEUTERON ELASTIC SCATTERING. Mitchell, C. K. Laramie, WY; Univ. of Wyoming (1973). 184p. University Microfilms Order No. 74-13,296.

Thesis (Ph. D.).

Vector-to-tensor polarization transfer coefficients in proton-deuteron elastic scattering were measured at outgoing deuteron laboratory angles of 0, 22.5, and 45° in the energy range 4.1 MeV ≤ E_p ≤ 9.1 MeV. The various vector-to-tensor polarization transfer coefficients are consistent with zero, in view of the errors, but effects of the order of ~0.05 cannot be ruled out. The $^3He(\vec{d},p)^4He$ reaction near the 430 keV resonance was used as the deuteron tensor polarization analyzer. The calculated vector-to-tensor polarization transfer coefficients agree well with the present measurements though there is some structure near a c.m. angle of 120° (corresponding to an outgoing deuteron laboratory angle of 30°). This class of transfer measurements seems to be somewhat insensitive to changes in the scattering amplitudes. Calculations of vector-to-vector polarization transfer coefficients, on the other hand, are large and appear more sensitive to such changes—both in $D(\vec{p},\vec{p})D$ and $D(\vec{p},\vec{d})H$ elastic scattering. This then may be a more fruitful place in which to look. It is not yet known whether the two-standard-deviation disagreement with the single measurement of K^*_x is significant. (Diss. Abstr. Int., B)

19836 STUDY OF THE PRODUCTION AND DECAY OF HYPERNUCLEI USING THE BEVATRON HEAVY ION BEAM. Nield, K. J. Tucson, AZ; Univ. of Arizona (1973). 72p. University Microfilms Order No. 74-12,448.

Thesis (Ph. D.).

The first hypernuclei production experiment using a beam of heavy ions from the LBL Bevatron is described. Mass-16 hypernuclei were produced by letting 33.6-GeV ^{16}O ions fall on a polyethylene target. These hypernuclei decayed in a wide-gap spark chamber, which was photographed. A decay distance distribution was obtained from these photographs. After appropriate cuts had been made, 22 good events remained. Analysis of these events gave a production cross section of 7.3^{+4}_{-3} microbarns. The lifetime of these hypernuclei was determined to be $(5.0^{+\infty}_{-3}) \times 10^{-11}$ seconds. This experiment shows that heavy-ion beams can be an invaluable tool in the further study of hypernuclei. (Diss. Abstr. Int., B)

Strong (Meson-induced)

19837 (COO-1545-143) EXPERIMENTAL STUDY OF THE REACTION $\pi^-p \rightarrow \Lambda K^0$ AT BEAM MOMENTA BETWEEN 930 AND 1130 MeV/c. Knasel, T. M.; Lindquist, J.; Nelson, B. (Chicago Univ., Ill. (USA). Enrico Fermi Inst.). 1973. 36p. Dep. NTIS $5.00.

An optical spark chamber spectrometer was used to perform a systematic study of the reaction $\pi^-p \rightarrow \Lambda K^0$ at beam momenta between 930 and 1130 MeV/c. The cross section, angular distribution, and Λ polarization were measured. The complete data are presented from a sample of 11,400 events along with Legendre polynomial coefficients for the angular distributions. No striking cross section enhancement at ΣK threshold is observed, but there is evidence for a small cusp effect. A simple model which takes account of the ΣK channel provides a good fit to the data. (auth)

19838 (IPNO-T-74-2) MEASUREMENT OF THE POLARIZATION PARAMETER P_0 IN $\pi^\pm p$ BACKWARD SCATTERING AT 6 GeV/c. Sillou, D. (Paris-11 Univ., 91−Orsay (France)). Jan 1974. 102p. (In French). Dep. NTIS (US Sales Only) $8.25.

Thesis.

The polarization parameter P_0 was measured in π^+p and π^-p backward elastic scattering using a butanol polarized proton target, a high intensity pion beam and a scintillation hodoscope detection system. Details of the apparatus and data analysis are described. The results are presented; they cover the four-momentum transfer region u = 0.03 to u = −.86(GeV/c)² in π^+p and u = 0.03 to u = −.93(Gev/c)² in π^-p. A variety of baryon exchange models is compared to both π^+p and π^-p results; none of them is found to be in complete agreement with all experimental data. (auth)

19839 (TID-26609) PION PRODUCTION IN 10.5 GeV/c $\pi^\pm$ − NEON COLLISIONS. Elliott, J. R.; Fortney, L. R.; Goshaw, A. T.; Loos, J. S.; Robertson, W. J.; Walker, W. D.; Yeager, W. M. (Duke Univ., Durham, N. C. (USA). Dept. of Physics). 1974. 49p. Dep. NTIS $5.50.

A systematic study was made of π-neon collisions at a bombarding energy of 10.5 GeV/c. The data were obtained using the SLAC 82" bubble chamber filled with a hydrogen-neon mixture (32 mole percent neon). The relatively long radiation length (125 cm) allows one to make good momentum measurements. The results of the survey so far are interesting in that they show rather small differences between hydrogen and neon collisions. For example, $\bar{n}_{\pi^0} = 2.00 \pm 0.2$ for neon as compared to 1.40 ± 0.14 for hydrogen. The rapidity distributions for neon and hydrogen collisions are very similar in the projectile fragmentation region, but quite different in the target fragmentation region. In the case of neon, one finds that on the average a sizeable fraction of the outgoing momentum is carried by nucleons (approximately 30 percent). The proton spectrum extends out to 5 GeV/c. Any picture of the collision process involving an electromagnetic type cascade must be qualitatively wrong. The nucleons involved in the collision are pushed out of the nucleus with considerable momentum transfer. (auth)

19840 (TID-26610) USE OF HIGH Z TARGETS. Walker, W. D. (Duke Univ., Durham, N. C. (USA). Dept. of Physics). [nd]. 8p. Dep. NTIS $4.00.

A set of experiments are proposed to measure the cross section of vector mesons on various projectiles. By using NAL energy π's incident on U cross sections of the order of a few tenths of millibarns are likely. (auth)

19841 PAIR CORRELATION OF PROTONS IN PION−CARBON INTERACTIONS AT MOMENTUM p = 7.5 GeV/c. Azimov, S. A.; Azimova, M.; Igamberdyev, K. R.; Lutfullaev, S. A.; Rizaev, Kh. A.; Yuldashev, A. A.; Yuldashev, B. S. (Physical-Technical Inst., Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 2, 15-17(1974). (In Russian).

The reaction $\pi^- + {}^{12}C \rightarrow p + p + \pi +$ residual nucleus was studied at p = 7.5 GeV/c in a bubble chamber. Correlation emission of protons was clearly detected. (JSR)

19842 DIFFRACTION DISSOCIATION OF π^- MESONS IN π^--p COLLISIONS WITH FORMATION OF SLOW RECOIL PROTONS. Azimov, S. A.; Til, E. A.; Chudakov, V. M. (Physical-Technical Inst., Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 1, 32-34(1974). (In Russian).

Criteria for the selection of diffraction dissociation in π^--p collisions with formation of slow recoil protons (T < 25 MeV) were formulated and applied to the examination of stars in emulsions irradiated with π^- mesons at 17 and 45 GeV/c. (JSR)

19843 DEUTERON EFFECTS AND K^{*0} PRODUCTION IN K + D → K^{*0}pp AT 1.94 GeV/c AND POOR MAN'S ABSORPTION ANALYSIS OF pp → Δ ++n AT 12.5 AND 16.9 GeV/c. Poster, R. A. Los Angeles; University of California (1973). 122p. University Microfilms Order No. 74-3982.

Thesis (Ph. D.).

A study was made of the reaction $K^+d \rightarrow K^+\pi^-pp(1)$ in an exposure of the Lawrence Berkeley Laboratory 25" deuterium filled bubble chamber to an electrostatically separated, 1.94 GeV/c, K^+ beam. A cross section of 3.23 ± 0.35 mb was found for (1). The production of the $K^{*0}(890)$ resonance in the process $K^+n \rightarrow K^{*0}p(2)$ was examined. A cross section of 1.72 ± 0.19 mb for (2) was found. This reaction is characterized by a strong forward peak which fits the distribution $d\sigma/dt = Ae^{Bt}$ for $.04 < -t < 0.30$ $(GeV/c)^2$ with A = 9.6 ± .3 (mb/GeV^2) and B = 6.7 ± .4 $(GeV/c)^{-2}$. A phase shift analysis of (2) and (3) is presented, and similar up-down s-wave solutions are found for the two data. The Kπ mass dependence of the L = 1 and L = 2 moments correspondingly shows similar behavior for (2) and (3). A simplified absorption model was proposed that attempts to describe a reaction such as (2). The poor man's absorption model gives parameter free predictions of moments ratios. These predictions are in excellent agreement with the data for (2) but in poor agreement with other data. This absorption model is applied to the reaction pp → $\Delta^{++}(1238)$n at 12.5 GeV/c and 16.9 GeV/c. The small t behavior of $\langle Y_2^0 \rangle$, $\langle \mathrm{Re}\, Y_2^1 \rangle$, and $\langle \mathrm{Re}\, Y_2^2 \rangle$ is adequately described by PMA. Details of the internal structure of the deuteron were studied from the data for reaction (1). A high spectator momentum component of (1) is found, 7% larger than predicted by the Hulthen wave function for P_{spec} >300 MeV/c. This component is associated with values of t near t_{min} in the t vs M_{pp} Chew-Low plane. A sample of these events chosen with large M_{pp} and small t comprises 25% of these high spectator momentum events. This sample is not consistent with multiple scattering on the constituents of the deuteron. However, these events can be understood if the impulse model (single scattering) is correct but the spectator momentum tail is much larger than expected from the Hulthen wave function, or the incident K^+ decays into a virtual state consisting of a K^{*0} and π^+ and the π^+ scatters on the deuteron. (Diss. Abstr. Int., B)

19844 GENERAL CHARACTERISTICS OF INELASTIC π^--COLLISIONS AT ENERGIES OF 45 GeV IN A PHOTOEMULSION. Azimov, S. A.; Gulamov, K. G.; Svechnikova, L. N.; Skripnik, N. S.; Trofimova, T. P.; Chernov, G. M. (Physical-Technical Inst., Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 1, 51-55(1974). (In Russian).

Data are considered on the multiplicity, charge transfer probabilities of nucleons and angular distributions for π^-n- and π^-p-collisions at p_0 = 45 GeV/c. A comparison with pN-collisions at 50 GeV/c is presented. It is shown that the angular distribution asymmetry is caused mainly by inaccuracy of the ultrarelativistic approximation; the angular distributions of the πN- and pN-events are the same; the momentum distribution is only a first approximation to the actual distribution of momentum. (SJR)

19845 EXPERIMENTAL STUDY OF THE REACTION $\pi^0 + p \rightarrow \rho^0 + p$ AT 15.0 GeV/c. Kaune, W. T. Stanford, CA; Stanford University (1973). 105p. University Microfilms Order No. 74-6496.

Thesis (Ph. D.).

The only one-particle t-channel exchange mechanism which is thought to contribute to the reaction $\pi^0 + p \rightarrow \rho^0 + p$ involves the exchange of an ω meson. Measurements of the differential cross sections and density matrices of the reactions $\pi^+ + p \rightarrow \rho^+ + p$ and $\pi^- + p \rightarrow \rho^0 + n$ were used to calculate the differential cross section and density matrix for $\pi^0 + p \rightarrow \rho^0 + p$ at 15.0 GeV/c. To make the required measurements a new technique was developed using optical spark chambers to view the decay products of the ρ mesons. The recoil proton was viewed for events where the square momentum transfer to the proton exceeded about 0.04 $(GeV/c)^2$. In the experiment, conducted at the Stanford Linear Accelerator Center, at 15.0 GeV/c 811 events were obtained from the channel $\pi^+ + p \rightarrow \rho^+ + p$, 772 from $\pi^- + p \rightarrow \rho^- + p$, and 817 from $\pi^- + p \rightarrow \rho^0 + n$. The differential cross sections and density matrix elements for these three channels are presented. The energy dependence of these quantities is determined by including data from other experiments. The differential cross section and density matrix elements for the reaction $\pi^0 + p \rightarrow \rho^0 + p$ at 15.0 GeV/c are calculated. These data have the general features expected in a reaction dominated by ω-exchange but fails to agree in the region $|t| \lesssim 0.3$ $(GeV/c)^2$ with a detailed calculation based on the dual-absorption model. A test of the vector dominance model is performed by comparing the two reactions $\gamma + p \rightarrow \rho^0 + p$ and $\pi^0 + p \rightarrow \rho^0 + p$. Agreement was found in shape but an overall normalization difference consistent only with a significant lower value of $\gamma_\rho^2/4\pi$. (Diss. Abstr. Int., B)

19846 MEASUREMENT OF PROTON–PROTON BREMSSTRAHLUNG CROSS SECTIONS AT 42 MeV. Greeniaus, L. G. Winnipeg, Manitoba; Univ. of Manitoba (1972). 251p.

Thesis.

Proton-proton bremsstrahlung (ppγ) cross sections have been measured at 42 MeV incident beam energy, using a wire chamber spectrometer developed for the study of three-body final states. PPγ events from a 22 cm long gaseous target were detected simultaneously over a large kinematic region. Polar angle ranges were from 14° to 42° and the maximum allowed event non-coplanarity could be detected for all observed proton polar angles. Resolutions were typically ±0.75° for the proton polar angles and ±25% of the maximum allowed non-coplanarity. The spectrometer was able to reject most random events by testing for an event vertex in the long gas target, resulting in significantly lower random background than for most previous ppγ experiments. The data have been analyzed by separating them into 18 independent polar angle regions and extracting the $d\sigma/d\Omega_1 d\Omega_2 d\Psi_\gamma$, $d\sigma/d\Omega_1 d\Omega_2$ and $d\sigma/d\theta_1 d\theta_2$ cross sections. These results have been compared to Liou's predictions for the Hamada–Johnston potential. The weighted mean ratio of Expt/Theory for the $d\sigma/d\theta_1 d\theta_2$ cross sections was 0.967 ± 4.6%. The data indicate that predictions of the Hamada–Johnston potential, with Coulomb corrections included, would be in good agreement with the measured cross sections. The data have also been analyzed by integrating over the observed proton polar angle ranges. The distribution of events as a function of the measured non-coplanarity is in excellent agreement with predictions of the Hamada–Johnston potential. Distributions of events versus Ψ_γ and the proton polar angle asymmetry are also in good agreement with the theoretical predictions. (auth)

19847 INCLUSIVE PRODUCTION OF LAMBDA AND NEUTRAL KAON IN K^-p INTERACTIONS AT 3.93 GeV/c AND 14.3 GeV/c. Borg, A. (CEN, Saclay, France); Bardadin-Otwinowska, M.; Barloutaud, R.; Louedec, C.; Moscoso, L.; Pierre, F.; Spiro, M. Nuovo Cim.; 22A: No. 4, 559-577(21 Aug 1974).

Lambda and neutral-kaon production is studied in K^-p interactions at 3.93 and 14.3 GeV/c. Topological inclusive cross sections are given at both energies. Invariant cross sections for lambdas and neutral kaons are presented as a function of the Feynman x-variable and are found to decrease in magnitude and vary their shapes with energy. The $\Lambda K\bar{K}$ production, which represents (9 ± 2)% and (29 ± 3)% of the lambda inclusive cross section at 3.93 GeV/c and 14.3 GeV/c respectively, yields mainly backward lambdas. The shapes of the transverse-momentum invariant distributions vary with x, but are roughly independent of energy. The lambda polarization is studied as a function of x at both incident momenta: for fast lambdas it is negative, as observed in reactions where nucleon exchange is dominant. (auth)

19848 TOTAL CROSS-SECTION FOR THE DOUBLE CHARGE EXCHANGE REACTION $\pi^+ + {}^4He \rightarrow \pi^- + 4p$ AT 100 MeV. Falomkin, I. V. (Joint Inst. for Nuclear Research, Dubna, USSR); Kulyukin, M. M.; Lyashenko, V. I.; Pontecorvo, G. B.; Shcherbakov, Y. A.; Georgescu, C.; Mihul, A.; Nichitiu, F.; Sararu, A.; Piragino, G. Nuovo Cim.; 22A: No. 3, 333-341(1 Aug 1974).

The cross section for the $\pi^+ + {}^4He \rightarrow \pi^- + 4p$ reaction was measured with a high pressure helium streamer chamber triggered by a scintillation counter hodoscope. Measurements were made for angles between 25 and 165°. Supposing the angular distribution of the secondary meson to be isotropic, the following total cross section was obtained for the double charge exchange: $\sigma_{tot} = (0.30 \pm 0.15) \cdot 10^{-27}$ cm^2. The obtained value turned out to be somewhat smaller than expected from calculations using the pair correlation model. (auth)

19849 QUASI-TWO BODY PROCESSES IN THE REACTIONS $\pi^+d \rightarrow pp\pi^+\pi^-$ AND $\pi^+d \rightarrow pp\pi^+\pi^-\pi^0$ AT 6.95 GeV/c. Matthews, J. A. J. Toronto; Univ. of Toronto (1971). 155p.

Thesis.

A 650,000 picture exposure in the 30" MURA ANL deuterium bubble chamber to π^+ mesons at 6.95 GeV/c is reported. The data

were used to analyze the charge-exchange reactions: $\pi^+n \rightarrow \omega^0p$ and $\pi^+n \rightarrow \phi(1680)p$; and were augmented by over 4000 events in the channel $\pi^-p \rightarrow \pi^+\pi^-n$, also at 6.95 GeV/c, to study the charge-exchange channels: $\pi N \rightarrow \rho^0N'$ and $\pi N \rightarrow g^0(1670)N'$. A simple Regge pole model including ρ, ρ' and B meson exchanges was found to represent the general form of the data. An analysis of the 1.68 GeV mass region of the $\pi^+\pi^-\pi^0$ mass spectrum in the $\pi^+d \rightarrow pp\pi^+\pi^-\pi^0$ data confirmed the existence of an $I^G = 0^-$ enhancement, the $\phi(1680)$, which was distinct from the $I = 1$ A_3 meson. This resonance was found to decay preferentially into $\rho\pi$ and was consistent with a 3π ($3\pi^+\rho\pi$) branching ratio of <30%. A spin-parity analysis of the 3π Dalitz plot for the $\phi(1680)$ favored natural spin-parity, $J^P = 1^-, 2^+, 3^-$ for spins $\lesssim 3$. The combined data from $\pi^+d \rightarrow pp\pi^+\pi^-$ and $\pi^-p \rightarrow n\pi^+\pi^-$ experiments has yielded a sample of 2380 events in the $\pi^+\pi^-$ mass interval $0.68 < m(\pi^+\pi^-) < 0.88$ GeV at the ρ^0 meson. The values of the ρ meson spin density matrix elements ρ_{00} and Re ρ_{10} in the Jackson frame for momentum transfers $|t| \lesssim 0.2$ $(GeV/c)^2$, and the form of the differential cross section $\rho_{00}(d\sigma/dt)$ calculated in the helicity frame suggested that absorption was important in this process. A spin-parity analysis of the $\pi^+\pi^-$ data from the combined π^+D and π^-p experiments favored a spin-parity assignment of $J^P = 3^-$ for the g^0 meson. (auth)

19850 ANALYSIS OF FIVE- AND SIX-PRONG MEASUREMENTS IN π^+d SCATTERING AT 7 GeV/c. Meiners, M. Toronto, Univ. of Toronto (1972). 112p.

Thesis.

An analysis is reported of a 650,000 picture exposure in the 30″ MURA-ANL deuterium bubble chamber to π^+ meson at 7 GeV/c. Measurements of 30,000 five and six prong events yielded the following reaction cross sections: 1, $\pi^+d \rightarrow p_sp\pi^+\pi^+\pi^-\pi^-$, $\sigma = 0.563 \pm 0.05$ mb; and 2, $\pi^+d \rightarrow p_sp\pi^+\pi^+\pi^-\pi^-\pi^0$, $\sigma = 0.952 \pm 0.045$ mb; and 3, $\pi^+d \rightarrow p_sn\pi^+\pi^+\pi^+\pi^-\pi^-$, $\sigma = 0.306 \pm 0.025$ mb. The cross section for missing mass events was found to be 2.85 ± 0.07 mb. Reactions 1 and 3 are compared to the charge symmetric reactions: A, $\pi^-p \rightarrow n\pi^+\pi^+\pi^-\pi^-$ and B, $\pi^-p \rightarrow p\pi^+\pi^+\pi^-\pi^-\pi^-$. There is evidence that rescattering effects in the deuteron play a dominant role in π^+d multiparticle production. The cross section for reaction 1 is significantly lower than the cross section for reaction A, which is 1.21 ± 0.11 mb. Distributions of the fitted reactions were compared to predictions of the CLA-amplitude. The model was able to describe the main features of single particle distributions and some of the invariant masses. Reaction 1 is dominated by ρ^0 and Δ^{++} production. The Δ^{++} is a decay product of N^{*+} formation in the mass range 1.4 to 1.8 GeV. A small Δ^0 signal is in agreement with this. The ratio of Δ^{++} to Δ^0 decay is between that predicted for the N^{*+} being $I = \frac{1}{2}$ and $I = \frac{3}{2}$. In reaction 2 the η and ω meson in the neutral 3π combination and a strong ρ^0 signal in the $\pi^+\pi^-$ mass are found. Charged ρ formation is small. (MGH)

19851 RECOIL PROTON POLARIZATION AND DIFFERENTIAL CROSS SECTION IN ETA-MESON PHOTOPRODUCTION AT 890 MeV. Ukai, K. (Tokyo Univ.); Endo, I.; Yoshida, K.; Hongoh, M.; Kikuchi, K. J. Phys. Soc. Jap.; 36; No. 1, 18-26(Jan 1974).

The differential cross section and recoil proton polarization for the process $\gamma + p \rightarrow \eta^0 + p$ were measured by detecting photons from η-decay and recoil protons. The differential cross sections are 0.75 ± 0.03 and 1.04 ± 0.07 μb/sr at the CM angles $\theta_\eta^* = 82.3$ and 108.3°, respectively, at the incident photon energy k = 890 Mev, and 0.20 ± 0.05 μb/sr at $\theta_\eta^* = 83.1$ and k = 1050 MeV. Thus the differential cross sections at k = 890 MeV seem to show a backward peaking. The value of recoil proton polarization is -0.15 ± 0.30 at $\theta_\eta^* = 82.3°$, whereas it is 0.27 ± 0.25 at $\theta_\eta^* = 108.3°$, both at k = 890 MeV, thus suggesting a sign change around $\theta_\eta^* = 90°$. In addition to the S_{11} (1535), a comparably large contribution of the D_{13} (1520) is needed to explain the experimental results. (auth)

19852 NEUTRON TIME-OF-FLIGHT SPECTROMETER STUDY OF f-ZERO AND A2-ZERO MESONS PRODUCED IN 4.5 GeV/c π^- PROTON INTERACTIONS. Nodulman, L. J. Urbana, IL; Univ. of Illinois (1973). 76p. University Microfilms Order No. 74-12,139.

Thesis (Ph. D.).

An optical spark chamber and neutron time-of-flight spectrometer experiment studied the reactions $\pi^-p \rightarrow \pi^+\pi^-n$ and $\pi^-p \rightarrow \pi^+\pi^-\pi^0n$ at incident pion momentum of 4.5 GeV/c in the mass region of the f^0 and $A2^0$ mesons. Results on the three pion final states are inconclusive due to statistical limitations and contamination of the data sample. The f^0(two-pion) mass spectrum prefers a simple Breit-Wigner resonance description to a dipole shape. Production of f^0 mesons with momentum transfers $|t| \gtrsim .7$(GeV/c) is more copious than expected from an OPE model and is characterized by natural parity exchange, as evidenced in the f^0 decay angular distributions. (Diss. Abstr. Int., B)

19853 QUASI TWO-BODY REACTIONS AND DIFFRACTION EXCITATION IN π^+p INTERACTIONS AT 6.5 GeV/c. Urratia, V. C. Indianapolis; Indiana Univ. (1973). 163p. University Microfilms Order No. 74-13,544.

Thesis (Ph. D.).

The results of an analysis of the interactions of π^+ mesons with protons at an incident beam momentum of 6.5 GeV/c are presented. The experiment was performed using the 30 inch hydrogen bubble chamber at Argonne National Laboratory. The final states $\pi^+p \rightarrow \pi^+\pi^+\pi^-p$ and $\pi^+p \rightarrow \pi^+\pi^+\pi^-\pi^0p$ were selected for a detailed study. A report is presented on the quasi two-body reactions $\pi^+\rho \rightarrow \rho^0\Delta^{++}$; $\pi^+p \rightarrow f^0\Delta^{++}$; and $\pi^+p \rightarrow \omega^0\Delta^{++}$. The production mechanisms for these reactions were investigated by examining the differential cross sections and the spin density matrix elements. Pion exchange is shown to dominate the $\rho^0\Delta^{++}$ and $f^0\Delta^{++}$ reactions while no single particle exchange can explain the $\omega^0\Delta^{++}$ data. Samples of the diffractively produced systems $\pi^+\pi^+\pi^-$ and $\pi^+\pi^-p$ were also selected from the data and the spin structure and production characteristics of these systems studied and compared with similar systems obtained in a π^-p exposure at 6.0 GeV/c. The data are consistent with an interpretation that spin structure for both the π^+p and the π^-p samples are identical and with production characteristics similar to those observed in elastic πp scattering. Finally, an attempt was made to isolate two- and three-body reactions with a center-of-mass angle selection technique. No evidence was found for three-body reactions. (Diss. Abstr. Int., B)

19854 MEASUREMENT OF THE DIFFERENTIAL CROSS SECTIONS FOR PION-PROTON ELASTIC SCATTERING AT 50 GeV/c. Tompkins, J. C. Los Angeles; Univ. of California (1974). 149p. University Microfilms Order No. 74-12,475.

Thesis (Ph. D.).

The differential cross sections for elastic pion-proton scattering were measured in a 50 GeV/c π^- beam at the 76 GeV/c proton synchrotron, IHEP, Serpukhov. The incident pions were scattered from a liquid hydrogen target and the tracks were recorded by a wire-spark-chamber magnetic spectrometer. The spectrometer consisted of eighteen wire-spark-chambers, two proportional wire chamber planes, and a 54 kilogauss-meter magnet for momentum analysis. A proportional chamber-analog electronics system was used to determine minimum scattering angles as part of the trigger requirements. Data are presented for four momentum transfer squared, t, in the range $0.03 < -t < 0.40$ $(GeV/c)^2$. The data are fit to the simple exponential form $d\sigma/dt = (d\sigma/dt)_{t=0} \cdot e^{-b|t|}$ yielding a slope parameter, $b = 9.07^{+0.30}_{-0.28}$ $(GeV/c)^{-2}$. The intercept at t = 0 is $(d\sigma/dt)_{t=0} = 30.6 \pm 0.9$ mb/$(GeV/c)^2$ in good agreement with the optical point value of 30.17 mb/$(GeV/c)^2$. The results are compared to previous experiments and some qualitative remarks are made regarding the high energy behavior of the pion-proton interaction. (Diss. Abstr. Int., B)

Particle Interactions and Properties (Theoretical)

Refer also to abstract 20206.

General

Refer also to abstracts 19827, 19957, 19963, and 20309.

19855 RANK STRUCTURE OF EXCLUSIVE REACTIONS. Morii, T. (Osaka Univ.); Noda, H. Progr. Theor. Phys. (Kyoto); 50: No. 2, 626-637(Aug 1973).

The origin of the rank structure of exclusive reactions is investigated. The relation between the threshold energy and the rank number is formulated. The phase space cross section and the t_1-cut cross section are considered. The rank structure of the cross section is characterized mainly by two aspects; the effect that the reactions with a higher rank number have higher threshold energy, and the suppression of the cross section by the t_1-cut mechanism. Also, the exchange mechanism arises a further suppression of the cross section with a higher rank number. (auth)

19856 CAUSALITY, CURRENT ALGEBRA, AND FIXED POLES. Abdel-Rahman, A. M. M.; Ahmed, M. A.; Taha, M. O. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev., D; 9: No. 8, 2349-2355(15 Apr 1974).

The causality restrictions on the structure of the nonforward matrix element of the commutator of two conserved isovector currents are studied. A fixed-pole interpretation of the noncausal contribution is given, a set of causality and current-algebra sum rules are derived, and the structure of the equal-time commutator is determined. (auth)

19857 LEHMANN–SYMANZIK–ZIMMERMANN STRUCTURE OF THE (n;3) SECTOR OF THE LEE MODEL AND SOME GENERAL FEATURES OF THE (n;k) SECTOR. Ulfu, F. S. (Univ. of Craiova, Romania). Ann. Phys. (Leipzig); 29: No. 4, 375-384(1973).

The Lehmann-Symanzik-Zimmermann (L. S. Z.) structure of the (n;3) sector of the Lee model is investigated and some general features of the (n;k) sector are presented. It is shown that the (n;k) sector with $k \geq n$ is entirely determined by the solutions of k singular integral equations. In the case of the sector (k−l; k) with l integer, $1 \leq l \leq k-1$, k − l singular integral equations must be solved in order to determine all physical quantities. (auth)

19858 CURRENT QUARKS, CONSTITUENT QUARKS, AND THE POINCARE GROUP. Buccella, F. (Univ., Rome); Savoy, C. A.; Sorba, P. Lett. Nuovo Cim.; 10: No. 11, 455-460(13 Jul 1974).

The unitary transformation between the light-like charges and the classification operator is derived directly from the study of the representations of the Poincare group, always in the case of free quarks. Starting from the properties of the light-like charges, one finds that the mixing operator appears in the reduction of the product of two irreducible representations of the Poincare group. Then it is shown in a very transparent way, that the current quarks which behave as the fundamental representation of the light-like charge algebra are related to the constituent quarks which correspond to the fundamental representation of the classification group, by a simple Wigner rotation. (JFP)

19859 INTERPOLATION FORMULA FOR TWO-PARTICLE DISTRIBUTION FUNCTION. Noda, H. (Ibaraki Univ., Mito, Japan); Kinoshita, K. Progr. Theor. Phys. (Kyoto); 50: No. 4, 1357-1363(Oct 1973).

An interpolation formula for the two-particle distribution function of the reaction a + b → c + d + anything is formulated using the Mueller multi-Regge expansion. (auth)

19860 FUNDAMENTAL PARTICLES. Ursu, I. (Institutul de Fizica Atomica, Bucharest). pp 237-264 of Energia Atomica. Bucharest; Editura Stiintifica (1973). (In Rumanian).

The elementary particle systematics, the interactions among particles and the laws of energy conservation are discussed. The characteristic quantities of the elementary particles, the resonances of the fundamental particles, the cosmic radiation are revealed, as well as the study of the fundamental particle interactions occurring in the relativistic accelerators. (INIS)

19861 ANALYSIS OF MULTIPARTICLE CORRELATIONS WITH MULTIPLE PARTICLE GENERATION. Chernov, G. M. (Physical-Technical Inst., Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 1, 69-70(1974). (In Russian).

A study of multiparticle correlations between particles generated in inelastic collision of high energy hadrons shows the existence of considerable difficulties because of the large fluctuations at relatively small multiplicity and small relative velocities of the generated clusters. Hence sensitive statistical criteria are necessary by which it is possible to determine the correlation and to study the mechanism of the cluster formation. A new way of analyzing inelastic interactions is proposed by which it is possible to obtain detailed information on the properties and type of multiparticle correlations. Consideration is given to a variational series (ordered selection) of n independent random numbers distributed in the interval (0,1) and all possible differences of the k'th member of the variational series. Expressions are presented for the distribution density, the mathematical expectation standard deviation. These expressions can be used in finding correlations of experimental data. (SJR)

19862 RELATIVISTIC CENTER-OF-MASS VARIABLES AND RELATIVISTIC CORRECTIONS TO PHENOMENOLOGICAL HAMILTONIANS. Liou, M. K. (Brooklyn Coll. of the City Univ.). Phys. Rev., D; 9: No. 4, 1091-1095(15 Feb 1974).

A new method for obtaining the relativistic internal center-of-mass variables without using the singular Gartenhaus–Schwartz transformation is proposed. We have shown that the relativistic c.m. dynamical variables can be obtained from the nonrelativistic ones by a unitary transformation. A general method for determining the relativistic interaction in terms of a given nonrelativistic phenomenological potential is developed. Many different results obtained previously by various approaches have been reproduced. (auth)

19863 RISING CROSS SECTIONS AND INCLUSIVE DISTRIBUTIONS. Czechowski, A. (Univ., Warsaw). Lett. Nuovo Cim.; 10: No. 12, 512-514(20 Jul 1974).

Some features of inclusive distributions which appear in a phenomenology with two simple poles: the leading one with 1 + g intercept and the second with unit (or lower) intercept. The aim is to compare predictions of the model which uses the three-pomeron vertex, and consequently renormalizes the pomeron-pole propagator with the recently published model in which three-pomeron coupling is neglected, and a four-pomeron vertex is used to renormalize the cut propagator only. (JFP)

19864 HIGH ENERGY PHYSICS INDEX. Volume 12, No. 12, 1974. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1974). 102p.

19865 ATOMIC STRUCTURE OF THE MATTER: HISTORY. Ursu, I. (Institutul de Fizica Atomica, Bucharest). pp 19-38 of Energia Atomica. Bucharest; Editura Stiintifica (1973). (In Rumanian).

The historical background of the atomic science is reviewed. Some fields, not so strongly connected today with nuclear energetics but which may lead to new trends in the use of the energy stored in the atom and nucleus, are also reviewed. These fields are: plasma physics, generation and stimulated emission of radiation (lasers, masers), as well as elementary particle physics. (INIS)

Electromagnetic

Refer also to abstract 19830.

19866 (DESY–73/40) TESTING GAUGE THEORIES IN e^+e^- EXPERIMENTS. An Introductory Summary. Dass, G. V. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Aug 1973. 25p. INIS.

3 tabs.; 25 refs.

A review is given of recently discussed tests of the 'spontaneously broken gauge theories of weak and electromagnetic interactions', as is possible with e^-e^- and e^+e^- interactions. An attempt was made to avoid mathematical details, the emphasis is only on the nature and magnitude of the effects. In some sections of the discussion, the maximum energy (3 GeV for e^+e^- beams) of the DESY machine was kept in mind. (orig./GE)

19867 (DESY–74/10) QUARK FRAGMENTATION FUNCTIONS IN HADRONIC AND DEEP INELASTIC SINGLE PARTICLE INCLUSIVE PROCESSES. Flume-Gorczyca, B. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Mar 1974. 10p. INIS.

2 figs.; 13 refs. With abstract.

Within the framework of Feynman's quark-parton model for inclusive electroproduction and the quark model of Ezawa, Maharana and Kiyazawa for hadronic inclusive processes, relations between invariant cross sections for electroproduction of pions and purely hadronic production of pions in the beam fragmentation regions are derived. They are satisfied by data. The u/d ratio of the parton fragmentation functions for π^+ production is estimated from purely hadronic processes independent of the parton model. (auth)

19868 ELECTROMAGNETIC MASS DIFFERENCES IN COMPENSATION THEORY. Wellner, M. (Syracuse Univ., NY). Phys. Rev., D; 9: No. 8, 2471-2473(15 Apr 1974).

A beginning is made toward developing a model where the electromagnetic mass differences between hadrons are constrained by requiring the finiteness of certain processes to lowest order in all coupling constants. The methods are taken over from a previously worked-out model, called compensation theory, in which electromagnetic masses were neglected. It is shown how a certain process, if assumed to be finite, yields the mass relation of Coleman and Glashow. SU(3) symmetry among the hadrons is not even approximately assumed at low energy. (auth)

19869 SYNCHROTRON RADIATION: A NEW RESEARCH TOOL. Marr, G. V. (Reading Univ., Eng.). Endeavour; 33: No. 119, 55-59(May 1974).

An accelerated electron radiates electromagnetic waves and an electron synchrotron acts as an intense source of ultraviolet and x-radiation since electrons with speeds approaching that of light are constrained to move on circular orbits within the synchrotron. Those properties of synchrotron radiation are described that are now being used to study a wide range of problems in physics, with particular reference to work on the 5-GeV electron synchrotron at Daresbury, UK. (auth)

19870 SCATTERING OF AN ELECTROMAGNETIC WAVE BY A FREE ELECTRON. Ashworth, D. G.; Jennison, R. C.

(Kent Univ., Canterbury, Eng.). J. Phys., A (London); 7: No. 7, 803-806(1 May 1974).

The laws of conservation of energy and momentum are used to eliminate Planck's constant from the usual relation for Compton scattering. The resulting expression is identical to the relativistic Doppler equation and it is shown that, in the proper frame of the interaction, Snell's law is obeyed and the scattering is specular. This leads to the possibility that the reflection occurs in a region rotating about the center of the electron at almost the velocity of light. (auth)

19871 EMISSION OF RADIATION BY ELECTRONS MOVING IN THE MAGNETIC ONDULATOR. Bagrov, V. G.; Khalilov, V. R.; Sokolov, A. A.; Ternov, I. M. (Moscow State Univ.). Ann. Phys. (Leipzig); 30: No. 1, 1-5(1973).

Using the methods of classical theory, the emission of radiation by electrons moving in an ideal magnetic ondulator of infinite length is investigated. The spectral angular distribution, the polarization, and the full radiated power are obtained. (auth)

19872 MEASURING THE NUCLEONIC WAVE FUNCTION IN THE DEEP-INELASTIC ELECTRON-NUCLEON COLLISIONS. Pavkovic, M. I. (New York Univ., New York). Phys. Rev., D.; 9: No. 4, 1054-1057(15 Feb 1974).

A most revealing relationship is discovered between the internal wave function of the nucleon—in the infinite-momentum Lorentz frame—and the directly measurable scaling function $F_2 = \lim_{\text{Bjorken}} \nu W_2$. For a single quark (parton), $F_2(\xi) = \xi(1-\xi)(1/a^2)\rho[(1-\xi)/a]$, $\xi = -q^2/2M_n\nu$, where a is the average hadronic level spacing and $\rho(r) = |\psi(\vec{x}_\perp)|^2$, essentially. In the general case of an arbitrary number of quarks (partons) the given expression preserves its validity, but $\rho(r)$ has a less obvious physical interpretation. The described discovery enables us to gain a penetrating insight in the very manner in which the dynamical disturbances propagate through the hadronic matter in the physical circumstances of deep-inelastic encounters. (auth)

19873 PSEUDOSCALAR-VERSUS-PSEUDOVECTOR INTERACTIONS IN PHOTO- AND ELECTROPRODUCTION OF CHARGED MESONS. Deo, B. B.; Bisoi, A. K. (Utkal Univ., Orissa, India). Phys. Rev., D; 9: No. 1, 288-295(1 Jan 1974).

The possibilities of distinguishing between pseudoscalar (ps) and pseudovector (pv) couplings by an analysis of experimental data on photoproduction and electroproduction processes are discussed. It is argued that the charged-K^+ electroproduction experimental results may be more reliable for the purpose. It is seen that "Born terms" can explain the qualitative features of some existing data on photo- and electroproduction of π and K mesons. (auth)

19874 POSSIBILITY OF USING THE PROCESS $\nu + e \rightarrow \nu + e + \gamma$ TO REGISTER NEUTRINOS OF ENERGY APPROX. 1 MeV. Zhizhin, E. D.; Konoplich, R. V.; Nikitin, Yu. P.; Rodionov, B. U. (Moscow Inst. of Engineering Physics). JETP Lett. (USSR) (Engl. Transl.); 19: No. 1, 36-38(5 Jan 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 1, 57-60(5 Jan 1974).

The possibility of using the elastic scattering of a neutrino by an electron, with emission of a photon ($\nu + e \rightarrow \nu + e + \gamma$) to register neutrinos of energy ~1 MeV. Some qualitative characteristics of the process are presented. The total cross sections of the processes $\nu + e \rightarrow \nu + e + \gamma$ and $\nu + e \rightarrow \nu + e$ are compared. (auth)

19875 POLAR-ANGLE DEPENDENCE IN π^+ ELECTROPRODUCTION NEAR THRESHOLD. Botterill, D. R. (Science Research Council, Daresbury, Eng.); Braben, D. W.; Norton, P. R.; Del Guerra, A.; Giazotto, A.; Giorgi, M. A.; Stefanini, A. Lett. Nuovo Cim.; 10: No. 14, 629-632(3 Aug 1974).

The angular distribution of pions in the c.m. system was measured for the process $e + p \rightarrow e + n + \pi^+$ near the electroproduction threshold for four different values of the four-momentum values of the four-momentum transfer for a virtual-photon polarization of $\epsilon = 0.96$. Also the total cross section and the azimuthal angular distribution were measured. (JFP)

19876 INDUCED RADIATION OF RELATIVISTIC ELECTRONS MOVING IN UNDULATORS. Mussa, A. Kh.; Pavlenko, Yu. G.; Petukhov, V. I. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 2, 199-204(1974). (In Russian).

The possibility of using undulators as sources of induced radiation was studied. (tr-auth)

19877 ASYMPTOTIC DOMAINS IN INCLUSIVE ELECTROPRODUCTION. Brandt, R. A. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Nuovo Cim.; 22A: No. 4, 461-506 (21 Aug 1974).

The behavior of current-induced single-particle inclusive amplitudes (current + hadron → hadron + anything, e.g. coincidence electroproduction) in the various Regge and scaling asymptotic domains is studied in a model-independent way. The Regge limits are those in which the amplitude is dominated by the exchange of single, double, or triple Regge or helicity poles and the scaling limits are those described by leading light-cone and short-distance singularities or parton dynamics. A unified treatment of these limits is presented and possible relations among the limits are deduced. The behavior in a number of further asymptotic domains is suggested from a study of overlapping domains. The main tool employed in the analysis is the systematic use of commutativity relations to relate and constrain the asymptotic behaviors. Many such relations can be deduced from integral representations (causal or Sommerfeld-Watson) but some relations are simply assumed. (It is not, however, assumed that different limits can be interchanged.) The result is a rather complete characterization of the amplitude in the interesting domains in terms of a few parameters. This characterization is illustrated in large multiple commutative diagrams which clearly display the many asymptotic domains and their relative structures and provide a comprehensive picture of the complicated multivariable dependence. Particular consequences of this approach are the smooth matching of the fragmentation and pionization regions and of the fragmentation and triple-Regge regions, the scaling behavior of the reggeon-current scattering amplitude, and a simple parametrization of the behavior in the current fragmentation region for large current mass. The final hadron multiplicity is discussed both in the Regge limit for large current mass and in the Bjorken limit. Any one of a number of further (but unproved) commutativity relations or limit interchanges are seen to lead to a log v multiplicity. (auth)

19878 PHOTON RADIATION IN CONSTANT PARALLEL ELECTROMAGNETIC FIELDS. Zhukovskii, V. Ch.; Nikitina, N. S. Vestn. Mosk. Univ., Ser. III. Fiz. Astron.; 15: No. 2, 189-192(1974). (In Russian).

The conditions for the quasi classical character were studied and the quasiclassical solution of the Dirac equation for electrons moving in a constant electric field and a magnetic field parallel to it. The photon emission in the parallel fields was calculated with consideration of the polarization and spin effects. It was shown that the formula obtained for the probability can be used for a description of the radiation of quasiclassical electrons in random constant and homogeneous electromagnetic fields. (tr-auth)

19879 ELECTRON IN THE FIELD OF A PLANE QUANTIZED MONOCHROMATIC ELECTROMAGNETIC WAVE. Bagrov, V. G.; Bozrikov, P. V.; Gitman, D. M.; Lavrov, M. M. (Tomsk Polytechnical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 55-58 (1973). (In Russian).

An exact solution is found to the Dirac equation for an electron moving in the field of a quantized, monochromatic, plane electromagnetic wave of arbitrary polarization. (SJR)

19880 ANALYSIS OF FIRE BALL BY USING RAPIDITY. Sawayanagi, K. (Waseda Univ., Tokyo). Uchusen Kenkyu; 17: No. 4, 421-475(Feb 1973). (In Japanese).

From symposium on charged particles and cosmic radiation; Hamamatsu, Japan (Dec 1971).

The investigation of characteristic features of the fireballs found in Chacaltaya emulsion chambers is discussed. By assuming the constant mass of H quantum and the quantum property of velocity, the system of center of mass and the static fireball system were obtained from observed shower energy. The decay of π^0 meson in the static fireball system was investigated, and the results of analysis in comparison with other results, the isotropy of fireball and the constant mass were studied. The rapidity $\textcircled{H}$ introduced by A. A. Robb was used as an important parameter. Study on the determination method of Lorentz factor γ_c and its propriety was made by using data by Rybicki and by Niu. The value of γ_c and the rapidity in the system of center of mass $\textcircled{H}_c$ were obtained for each event. The isotropy of secondary particles was studied by the distribution of $\textcircled{H}-\textcircled{H}_c$. A new method for the analysis of events with $\Sigma E\gamma$ more than 10 TeV is introduced and the results of analysis are shown. The distribution of $\textcircled{H}-\textcircled{H}_c$ was in agreement with that of the isotropic emission of π^0 mesons in static H-quantum system. The separation of H-quantum by the plot of log tan $\theta-(\textcircled{H}-\textcircled{H}_c)$ was made, and the identity of separated fireball was seen. (auth)

Weak

Refer also to abstracts 20226, 20285, and 20312.

19881 (RL-74-38, pp Paper 6) EXPERIMENTAL SITUATION ON NEUTRAL WEAK CURRENTS. Perkins, D. H. (Oxford Univ.). 1973.

From school for young high energy physicists; Chilton, UK (15 Jul 1973).

It is stated that there are two really outstanding problems in high energy physics today. One of these is to understand the "spectroscopy" of the multitude (~300) of hadronic states which were identified over the last years. The other problem is to try to understand the nature of, and the inter-relation between, the different types of interaction field, of which there are at least six. These interactions are listed. Each field is specified by a coupling "constant" typical of the particular interaction. The subject is considered under the following headings: unified theories of weak interaction and electromagnetic interaction; the Weinberg model of neutral currents; leptonic neutral currents; reactor experiment on $\bar{\nu}_e + e^- \rightarrow e^- + \bar{\nu}_e$; CERN experiment on $\nu_\mu + e^- \rightarrow e^- + \nu_\mu$ and $\bar{\nu}_\mu + e^- \rightarrow e^- + \bar{\nu}_\mu$; hadronic neutral weak currents; future possibilities for the study of leptonic neutral currents. (UK)

19882 HADRONLIKE BEHAVIOR OF THE PHOTON IN DEEP INELASTIC LEPTON–NUCLEON SCATTERING. Bajpai, R. P.; Mukherjee, S. (Himachal Pradesh Univ., Simla, India). Lett. Nuovo Cim.; 10: No. 11, 471-474(13 Jul 1974).

It is shown that the quark–parton results for deep inelastic lepton–nucleon scattering exhibit some general features of strong interactions. The agreement is qualitative. If verified experimentally, these quark–parton results may have an important bearing on the question of a dominant hadronic structure of the photon. (JFP)

19883 MAGNITUDE OF CONTRIBUTIONS FROM VARIOUS CURRENTS IN NEUTRINO REACTIONS. Ezawa, Y.; Senba, K.; Yano, T.; Noda, M. T. (Ehime Univ., Matsuyama, Japan). Lett. Nuovo Cim.; 10: No. 11, 475-478(13 Jul 1974).

Contributions from the vector, axial vector, and the isoscalar currents in neutrino reactions are evaluated by using recent experimental data. Admissible ranges of contributions from these currents are determined based on a positivity condition, and these are evaluated numerically from the experimental values. (JFP)

19884 CONSTRAINTS ON THE MEAN VALUES OF OBSERVABLES IN NEUTRINO REACTIONS. Ezawa, Y.; Senba, K.; Yano, T.; Noda, M. T. (Ehime Univ., Matsuyama, Japan). Lett. Nuovo Cim.; 10: No. 11, 479-483(13 Jul 1974).

The theoretical relations among various observables for the reactions: $\nu_\mu + N \rightarrow \mu^- +$ hadrons and $\bar{\nu}_\mu + N \rightarrow \mu^+ +$ hadrons, in addition to those of Eichten et al. (Phys. Lett., 46B, 274(1973)) were examined under similar assumptions as those, and these are evaluated numerically from experimental data. (JFP)

19885 HEAVY LEPTONS AND UNIFIED THEORIES OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Alles, W. (Univ., Bologna). Lett. Nuovo Cim.; 10: No. 11, 441-447(13 Jul 1974).

Models are constructed in which universality can be obtained without introducing heavy leptons, and if these have to be introduced at all, they have to, only to eliminate Adler anomalies. In this way one arrives at heavy leptons with couplings, production, and decay properties differing from the earlier predicted ones, and that, therefore, could have easily escaped experimental detection. (JFP)

19886 LEADING DIVERGENCES OF WEAK NNρ AMPLITUDES. Guberina, B.; Missimer, J.; Tadic, D. (Rudjer Boskovic Inst., Zagreb). Phys. Rev., D; 9: No. 8, 2456-2464(15 Apr 1974).

Light-cone and Bjorken-Johnson-Low limiting procedures are applied to nonleptonic decay amplitudes describing weak virtual vector-meson emission. Reducing the vector meson from the decay state via the Lehmann-Symanzik-Zimmermann reduction formalism before applying the limiting procedures produces divergences whose coefficients do not vanish in a simple model of SU(3)-symmetry breaking. The leading divergences of the amplitudes produce a cutoff-dependent potential whose most significant feature is a coupling constant as much as two orders of magnitude larger than and of the opposite sign from that of the separable-approximation potential. Also, neutral-ρ-meson exchange contributes as much to the potential as charged-ρ exchange. The consequences of this potential for parity-violating nuclear processes are examined. (auth)

19887 RADIATIVE CORRECTIONS TO μ DECAY IN THE SO(3) GAUGE MODEL. Hagiwara, T. (State Univ. of New York, Stony Brook). Phys. Rev., D; 9: No. 4, 1023-1041(15 Feb 1974).

We have examined the radiative corrections to μ decay in the SO(3) gauge model. Quantizing a theory in the generalized R_η formalism, we have proved by actual calculation that the theory yields a gauge-independent S matrix and is unitary when all the contributions are summed up. Taking the dimensional regularization method, we carried out the renormalization program in the Landau gauge, in which the ultraviolet divergences are shown to be eliminated by rescaling of the independent physical parameters and the wave functions in the original gauge-symmetric Lagrangian. We have also shown how to introduce an infinitesimally small mass to a photon without breaking the renormalizability of the theory in order to treat the infrared problem. We have then obtained the finite radiative corrections to μ decay without either ultraviolet or infrared divergences. The theory is indistinguishable from the classical theories of weak interactions as long as we observe only the μ decay, neglecting terms of order $O(\alpha m_\mu^2/M_w^2)$. Similarly, we have computed the finite radiative corrections to β decay. The ratio of μ- and β-decay coupling constants is now model-dependent. In the case of the SO(3) gauge model, it depends on the fermion mass spectra of the model. (auth)

19888 IMPLICATIONS OF A SPIN-0 W-MESON THEORY OF THE WEAK INTERACTIONS. McNamee, P. C. (Universidade Carolica, Rio de Janeiro). Phys. Rev., D; 9: No. 1, 275-287(1 Jan 1974).

Some experimental implications of a recently proposed model of the weak interactions are discussed; in this model, a spin-0 boson, W, mediates the weak interactions. Some ordinary weak interactions (muon decay, neutrino-electron scattering, radiative semileptonic pion decay) are calculated, and it is found that a W of reasonable mass cannot be detected in these interactions. Some representative production cross sections are estimated ($e^+e^- \rightarrow W^+W^-$, $\pi p \rightarrow Wp$, $\nu_\mu p \rightarrow \mu^- W^+ p$), and it is found that the last-mentioned cross section is very small. The decay scheme of the W is discussed; the decay $W \rightarrow \mu\nu$ is probably the dominant mode if $m_w \leq 1$ BeV; for higher mass, hadron channels may dominate.

19889 BETA DECAY AND MUON CAPTURE. Morita, M. Reading, MA; Addison-Wesley/W. A. Benjamin, Inc. (1973). 371p. $19.50.

The topics discussed are Fermi theory of beta decay, the discovery of parity nonconservation in beta decay, the V–A theory, forbidden transitions, nuclear structure problems studied from beta decays, muon capture, nuclear structure problems studied from muon capture reactions, and recent developments in the study of beta decay and related processes. (JFP)

19890 SENSITIVITY TO THE PRESENT EXPERIMENTAL SITUATION OF A RECENT TEST OF CABIBBO'S MODEL. Garcia, A. (IPN, Mexico City). Nuovo Cim.; 22A: No. 3, 342-344(1 Aug 1974).

A recent test of Cabibbo's model relies strongly on the experimental values of the spin asymmetries in $\Lambda \rightarrow pe\nu$ and $\Sigma^- \rightarrow ne\nu$. The stability of such a test is studied by considering different choices of the data for these quantities. (auth)

19891 WEAK NEUTRAL CURRENTS IN ATOMS AND μ-MESIC ATOMS. Moskalev, A. N. (Leningrad Inst. of Nuclear Physics). JETP Lett. (USSR) (Engl. Transl.); 19: No. 4, 141-143(20 Feb 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 4, 229-232(20 Feb 1974).

It is shown that weak neutral $\bar{e}e$ currents lead to circular polarization of the photons in the single-quantum transition $2S_{\frac{1}{2}} \rightarrow 1S_{\frac{1}{2}}$ in the hydrogen atom, with a value $-0.25 \times 10^{-3}\, G_v/G$, where G_v/G is the ratio of the interaction constants of the neutral and charged currents. The polarization of the gamma quanta in the analogous transition in the mu-mesic hydrogen atom is $5 \times 10^{-2}\, G_v/G$. (auth)

19892 NEUTRAL WEAK CURRENTS. Pontecorvo, B. (Joint Inst. of Nuclear Research, Dubna, USSR). JETP Lett. (USSR) (Engl. Transl.); 19: No. 4, 143-145(20 Feb 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 4, 233-235(20 Feb 1974).

One four-fermion interaction variant connected with neither intermediate particles nor with the concept of weak neutral currents is considered. This variant could lead, in principle, to the existence of process of the type $\nu_\mu + N \rightarrow \nu_\mu +$ hadrons and $\nu_\mu + e \rightarrow \nu_\mu + e$. (auth)

19893 ISOTOPIC AND CHIRAL STRUCTURE OF NEUTRAL CURRENT. Kopeliovich, V. B.; Frankfurt, L. L. (Leningrad Inst. of Nuclear Physics). JETP Lett. (USSR) (Engl. Transl.); 19: No. 4, 145-147(20 Feb 1974).

Translated from Zh. Eksp. Teor. Fix., Pis'ma Red.; 19: No. 4, 236-239(20 Feb 1974).

Relations are obtained between the cross sections for ν and $\bar{\nu}$ scattering by nuclei; these relations explain the isotopic and chiral structure of the neutral current. It is shown that the cross

section for the interaction of low-energy neutrinos is enhanced by the coherence effect, and processes in which charged current participates are suppressed by virtue of the Pauli principle. (auth)

19894 EXACT BOUNDS FOR THE FORM FACTOR OF K_{13} DECAY. Tataru, L. (Univ. of Helsinki). Acta Phys. Pol.; B5: No. 3, 361-371(1974).

Assuming the Callan–Treiman and Dashen, Li, Pagels, Weinstein relations, exact inequalities for the K_{13} scalar form factor f(t) and its derivatives have been studied. These inequalities are too stringent to fit with the experimental data. Only for a very large value of the propagator $\Delta(0)$ of the divergence of the strangeness changing current at zero momentum there is a better agreement. Various causes of this disagreement are analyzed. (auth)

19895 RADIATIVE DECAY OF Σ^+ HYPERON. Malakyan, Yu. P. (Inst. of Physical Research, Erevan). JETP Lett. (USSR) (Engl. Transl.); 19: No. 1, 43-46(5 Jan 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 1, 68-72(5 Jan 1974).

A low-energy theorem connecting the weak processes $\Sigma^+ \to p\gamma$ and $\Sigma^+ \to p\pi^0\gamma$ is derived by using the PCAC hypothesis in standard fashion. Using this theorem, the amplitudes of the first transition are expressed in terms of the S-wave of the nonleptonic decay $\Sigma^+ \to p\pi^0$. The probability and asymmetry parameter of the $\Sigma^+ \to p\gamma$ decay are obtained. The results agree well with the experimental data. The difference between the presented analysis and an analogous approach is also explained. (auth)

19896 RADIATIVE CORRECTIONS TO HIGH ENERGY NEUTRINO REACTIONS. Frenkel, J. Madison, WI; Univ. of Wisconsin (1973). 90p. University Microfilms Order No. 74-7466.

Thesis (Ph. D.).

The radiative corrections to the high energy neutrino reactions are examined assuming the phenomenological local current-current theory. To this end, first the radiative amplitude for these processes are considered. The low momentum domain of the amplitude is calculated by using a generalization of the Low method, while the high momentum domain is determined by using a variant to the Bjorken technique. It is found that the electromagnetic radiative corrections are logarithmically divergent. It is shown that the finite part of the radiative corrections behaves like log (s/M^2), where s is the square of the total center of mass energy, which can modify significantly, by about 10%, the uncorrected cross section. (Diss. Abstr. Int., B)

Strong (General)

19897 LINES OF QUANTISED MAGNETIC FLUX AND THE RELATIVISTIC STRING OF THE DUAL RESONANCE MODEL OF HADRONS. Tassie, L. J. (Australian National Univ., Canberra). Int. J. Theor. Phys.; 9: No. 3, 167-178(Mar 1974).

The quantization of magnetic flux and the quantization of electric charge follows from requiring the same invariance properties under time reversal of both classical and quantum systems. The action integral for a line of quantized magnetic flux is the area of the surface traced out in space-time by the motion of the line. It is suggested that the relativistic string of the dual resonance model of hadrons is a line of quantized magnetic flux. Accordingly, quarks have magnetic charge. Assuming quarks of magnetic charge +g, –2g, baryons are composed of three quarks. States of one, two, four or five quarks will not normally occur. An explanation is given of the failure to produce free quarks. (auth)

19898 MAGNETIC SUSCEPTIBILITY OF SUPERDENSE SYSTEMS AND THERMODYNAMICS OF STRONG INTERACTIONS. Bansal, K. G.; Panchapakesan, N. (Univ. of Delhi). Phys. Rev., D; 9: No. 4, 839-843(15 Feb 1974).

Magnetic susceptibility of a system of neutrons at very high densities is calculated. The strong interactions are included by specifying the hadron resonance spectrum and using the thermodynamic theory of Hagedorn and others. A knowledge of the relation between average spin and mass is also necessary. For one such plausible relation the susceptibility is shown to increase with an increase in density contrary to the decrease for a noninteracting fermion system. The increase is due to the very slow increase in Fermi energy because of the production of higher-mass particles, and to the increase in spin of such particles. (auth)

19899 IS THE WILLIAMS MODIFICATION OF ONE-PION-EXCHANGE AMPLITUDES EQUIVALENT TO THE ADDITION OF CROSSED-CHANNEL EXCHANGES? Glueck, M. (Univ., Marburg, Ger.). Phys. Rev., D; 9: No. 1, 253-256(1 Jan 1974).

It is shown that for the processes $np \to pn$ and $\gamma p \to \pi^-\Delta^{++}$, the Williams method of modifying the one-pion-exchange amplitude is not equivalent to the addition of crossed-channel particle exchanges. (auth)

19900 STATISTICAL TREATMENT OF KOBA–NIELSEN–OLESEN SCALING. Kikkawa, K.; Ma, E. (City College of City Univ., New York). Phys. Rev., D; 9: No. 1, 120-123(1 Jan 1974).

Assuming that the statistical treatment is possible in particle productions, we show that the early onset of Koba–Nielsen–Olesen scaling occurs if the statistical system produced in the hadronic collision has a Debye cut. A specific model is examined in detail. (auth)

19901 THEORY OF POMERON INTERACTION. Migdal, A. A.; Polyakov, A. M.; Ter-Martirosyan, K. A. (Inst. of Theoretical Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 19: No. 4, 147-150(20 Feb 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 4, 239-243(20 Feb 1974).

The theory of pomeron interaction is considered with the aid of the strong-coupling method and the ϵ-expansion method. (auth)

19902 RELATIVISTIC EXPANSION OF AMPLITUDES AND THE PARTON MODEL. Smorodinskii, Ya. A. (Joint Inst. of Nuclear Research, Dubna, USSR). JETP Lett. (USSR) (Engl. Transl.); 19: No. 1, 34-35(5 Jan 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 1, 55-57(5 Jan 1974).

It is shown that it is convenient to describe the properties of the parton model in a 4-dimensional cylindrical coordinate system. The connection between the relativistic numbers and the concept of relative coordinates is elucidated. (auth)

19903 STRUCTURE OF POMERANCHUK POLE AND INCLUSIVE SPECTRA. Gendenshtein, L. E.; Kaidalov, A. B.; Chernavskii, D. S. (Physical-Technical Inst., Kiev). JETP Lett. (USSR) (Engl. Transl.); 19: No. 1, 38-41(5 Jan 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 1, 61-65(5 Jan 1974).

The connection between the approach to scaling in the inclusive reactions and the clustering of the produced particles is considered. The analysis is carried from the point of view of the multiperipheral model. It is shown that the behavior of the inclusive spectra depends on the ratio of the densities with respect to the rapidity of the detected particles in fragmentation clusters (resonances) and in central ones. (auth)

19904 MULTIPLICITY DISTRIBUTION MODEL BASED ON CLUSTER ASSUMPTION IN HIGH-ENERGY HADRONIC COLLISIONS. Yokoyama, K. I. (Hiroshima Univ., Takehara, Japan); Minakata, H.; Namiki, M. Progr. Theor. Phys. (Kyoto); 51: No. 1, 212-223(Jan 1974).

In order to describe the feature of correlations among produced particles in high-energy hadronic collisions, a new type of multiplicity distribution is introduced. The distribution can be derived from some simple assumptions of clustering for produced particles, and it corresponds to a modified Pólya distribution in which two parameters are included besides the averaged multiplicity. Under some conditions given for these parameters in stochastic and clustering sense, it is shown that the distribution can lead to two- and three-particle correlation parameters consistent with the data in the $70 \sim 300$ GeV/c region of incident momentum in proton–proton collisions. Some possible parametrizations lead to the Koba–Nielsen–Olesen scaling as well as the above. (auth)

19905 BORN DUALITY AND STRINGS IN HADRODYNAMICS AND ELECTRODYNAMICS. Tze, H. C. (Univ. of Copenhagen). Nuovo Cim.; 22A: No. 4, 507-526(21 Aug 1974).

A dimension-selecting duality principle is proposed for electrodynamics and for hadrodynamics of relativistic strings. Dual theories are identical in formal structure to Maxwell's electrodynamics. Maximal dual systems must be two dimensional, with as their simplest examples all the strings of dual-resonance models. Minimal dual systems are realized by Born-Infeld electrodynamics in four dimensions. From these two infinite classes of theories, the added constraints of general covariance and shock-free wave propagation single out uniquely two exceptional systems. One is the Nambu string, the other is the original Born Lagrangian admitting Nambu-string solutions in its strong-field limit. Our analysis stresses the physics and naturalness of string structures in guage theories. It leads to a geometro-dynamical interpretation of the duality principle. (auth)

19906 CURRENT-HADRON SCATTERING AND SCALING IN A DUAL RELATIVISTIC QUARK MODEL. Venturi, G. (Univ., Bologna). Nuovo Cim.; 22A: No. 3, 371-385(1 Aug 1974).

A meromorphic amplitude with satisfactory high energy behavior and scaling properties is constructed for the scattering of a current off a pseudoscalar hadron. The amplitude has a quark model mass spectrum and factorization properties on the leading trajectory. The current-hadron coupling is mediated by an infinite number of vector mesons and the hadron form factors obtained are satisfactory. The divergence conditions on the amplitude are examined and the possible ways of implementing gauge invariance are mentioned. The light-cone structure of the amplitude is then discussed particularly with respect to the relevance of the light cone for the derivation of fixed-mass sum rules. It is found that besides the usual singularity there is an additional one associated with the discontinuity on the external current legs. Lastly the conditions for which the quark model relation between the deep inelastic structure functions emerges and the behavior of the structure functions for $\omega\ (= -q^2/p \cdot q) \to 2$ are discussed. (auth)

19907 GENERALIZED CONFORMAL GAUGE CONDITIONS IN DUAL MODELS. Konisi, G. (Kwansei Gakuin Univ., Nishnomiya, Japan); Saito, T. Progr. Theor. Phys. (Kyoto); 51: No. 1, 284-298(Jan 1974).

On the basis of conformal invariance in the string model of hadrons we determine the interaction of the string with external field. It is shown that the string is allowed to couple with the external field only at both end points of the string with arbitrary coupling constants. We find generators $\tilde{L}_n$ of the conformal transformation in the interacting case; they satisfy the same conformal gauge algebra as L_n in the free case. We also find generalized conformal gauge conditions in the interacting case. These new conditions assure the absence of ghosts, though the usual off-shell Virasoro conditions do not hold. The same problems are also discussed in the dual pion and fermion models. (auth)

19908 MULTI-LOCAL HADRON FIELDS. A Systematics of Hadrons in the Ur-Citon Scheme. Ishida, S. (Nihon Univ., Tokyo); Oda, M.; Yamazaki, Y. Progr. Theor. Phys. (Kyoto); 50: No. 6, 2000-2026(Dec 1973).

Necessary and useful formulas for a systematics of all hadrons in the ur-citon scheme, where all the nonexotic mesons and baryons are treated unifiedly as multi-local fields, are collected, some of which have been partly given in previous works. These multi-local fields, which are generally tensors in $\tilde{U}(12) \times O(3,1)$ space and reduce to tensors in $SU(6) \times O(3)$ space in the rest frame, are expanded explicitly into "Fierz component local fields" with irreducible $SU(3) \times SU(2)$ properties in $\tilde{U}(12)$ space. As for the level scheme it is shown that the completely same one as in the usual quark model is reproduced by imposing new subsidiary conditions from "multi-particle pictures"; and present situations for the validity of universal slope of L (inner orbital momentum)-$(\text{mass})^2$ plot are presented, which is a necessary result of the scheme. Bilinear forms of multi-local fields are also explicitly expressed in terms of the local fields and the results are tabulated, which may be useful for future applications. As a general result of these tables F/D ratios of the Yukawa vertices between general octet baryons are discussed. (auth)

19909 SINGULAR POTENTIALS AND SOME ASPECTS OF STRONG INTERACTION PHYSICS. Misra, R. C. Fredericton, New Brunswick; Univ. of New Brunswick (1971). 77p.

Thesis.

In this thesis, singular potentials of the form r^{-n}, $n > 3$, have been studied with a view to understanding some features of strong interaction. For an r^{-4} potential, the Schroedinger equation can be put in the form of a modified Mathieu equation. Singular potentials are used to examine rising Regge trajectories in energy independent and energy dependent schemes. The trajectories seem to be rising nonlinearly. The conditions for rising Regge trajectories are given. An N/D decomposition of the partial wave scattering amplitude is studied for singular potentials and also for singular Yukawa potentials. In the former case, an N/D solution could exist utmost with a finite cut $0 < k \leq K$, and for the latter case, a standard N/D solution is possible where the functions N and D have usual properties. Duality of strong interaction is discussed; in particular, singular potentials are shown to exhibit a complete mathematical duality for a limited range of the invariant variable in the crossed channel. (auth)

19910 VERTEX FUNCTION IN THE BI-LOCAL FIELD. Goto, T.; Naka, S. (Nihon Univ., Tokyo). Progr. Theor. Phys. (Kyoto); 51: No. 1, 299-308(Jan 1974).

To make preparation for constructing the symmetric vertex function in the string model of hadrons, we study the symmetric vertex in the bi-local field model of hadrons. It is shown that the vertex operator is obtained by following the quark line picture and employing the vertex operator we can obtain the amplitude for the scattering of two bi-local fields. Unfortunately the asymptotic behaviour of the scattering amplitude obtained here is not good enough as a whole. (auth)

19911 LIGHT CONE AND THE ELASTIC SCATTERING AMPLITUDE. Hirayama, M. (Toyama Univ., Japan). Progr. Theor. Phys. (Kyoto); 51: No. 1, 230-241(Jan 1974).

The high energy elastic scattering is investigated in the coordinate space. The light-cone dominance is shown to apply to any of the forward, backward and large-angle scattering amplitudes. The relevant light cone for each case is expressed in a simple form by making use of the scattering angle in the center-of-mass system. (auth)

Strong (Baryon No. = 0)

Refer also to abstract 20274.

19912 MULTIPLICITY DISTRIBUTIONS IN $\bar{p}$-p COLLISIONS. Minami, S. (Osaka Univ.). Lett. Nuovo Cim.; 10: No. 11, 466-470(13 Jul 1974).

The 2n-prong cross sections in $\bar{p}$ + p scattering responsible for $\sigma_{tot}(\bar{p}-p) - \sigma_{tot}(p-p)$ is studied, and the multiplicity distributions in $\bar{p}$-p collisions at 5 to 200 GeV/c are discussed. (JFP)

19913 RISING DRELL FACTOR. Ito, K. R. (Univ., Kyoto). Lett. Nuovo Cim.; 10: No. 12, 535-539(20 Jul 1974).

Since for $e^+ + e^-$ — hadrons it is found that there is a unitarity bound on the Drell factor, if the virtual parton-antiparton scattering amplitude is dominated by the mass-shell amplitude, this amplitude is investigated in the framework of the parton model and field theory. The analysis shows that the multiplicity grows as the energy grows. (JFP)

19914 INCLUSIVE ANALYSIS OF $\bar{p}n$ ANNIHILATIONS BETWEEN 1.0 AND 1.6 GeV/c. Borreani, G. (Univ., Turin); Manetta, V.; Quassiati, B. Lett. Nuovo Cim.; 10: No. 12, 529-534(20 Jul 1974).

Data from $\bar{p}$ interactions on deuterium at seven different momenta between 1.0 and 1.6 GeV/c are analyzed inclusively for longitudinal and transverse momenta. It is found that the momentum distributions are in fairly good agreement with the thermodynamical model. But a Regge-Mueller analysis such as Rittenberg-Rubenstein model does not fit missing-mass and momentum transfer distributions. (JFP)

19915 ASYMPTOTIC LEVEL REALIZATION OF SU(3) AND GENERAL SU(3) PARTICLE MIXING AMONG THE MESONS. Laankan, T. College Park, MD; Univ. of Maryland (1973). 150p. University Microfilms Order No. 74-13,183.

Thesis (Ph. D.).

The problem of general SU(3) mixing between different SU(3)-multiplets of mesons is studied in the framework of asymptotic SU(3), chiral $SU(3) \otimes SU(3)$ charge algebra with the model of symmetry breaking characterized by the presence of the exotic commutation relations $[\dot{V}_{K^0}, V_{K^0}] = [V_{K^0}, V_{\pi^-}] = 0$ etc. (where $\dot{V}_{K^0} = (d/dt)\, V_{K^0}$, $V_{K^0} = V_8 + iV_7$ etc.), and asymptotic level realization of SU(3) in the algebra $[A_i, A_j] = if_{ijk}V_k$. The simple $\bar{q}q$ model is used as a guide. First the idea of level realization of SU[3] in the algebra $[A_i, A_j] = if_{ijk}V_k$ is studied in general, and it is proved for the two lowest levels (L = 0 and L = 1) the level realization reduces to the realization by each meson nonet belonging to these levels. One considers the mixing between two vector meson nonets with $J^{PC} = 1^{--}$, but belonging to different L-excitations. A mixing that breaks unitary spin but preserves isospin is assumed. One first treats mixing between the I = 1 and I = ½ members. Then a scheme of broken SU(3) matrix element relations of the axial vector charge A_i is established, which is used to study mixing among the I = 0 members. Using level realization of SU(3) of the full charge algebra under consideration, it is shown that the nonet-nonet mixing considered, although in general present, will not contribute to sum rules and decay rates. Thus the only important mixings are found to be the ones between the I = Y = 0 members of each nonet. Sum rules in the presence of general SU(3)-mixing are derived. The mixing between the I = ½ members (K_A and K_B) of the axial vector meson nonets of $J^{PC} = 1^{++}$ and 1^{+-} is studied, allowing for the possibility of general SU(3)-mixing. It is shown that such $K_A - K_B$ mixing can take place only to the extent that the 1^{--} (L = 0) vector mesons deviate from ideal nonet structure and therefore is small. Furthermore the sum rules are consistent with the almost ideal nonet structure for the 1^{++} nonet. The $K_A - K_B$ mass spectrum and the D-meson decay modes are discussed in the light of this possibility. It is found that the present data are consistent with the 1^{++} nonet being almost ideal. Finally the corrections to Schwinger's nonet formula due to $K_A - K_B$ mixing are derived. (Diss. Abstr. Int., B)

19916 NUCLEON–ANTINUCLEON ANNIHILATIONS INTO PIONS. Venitis, B. Athens, OH; Ohio Univ. (1973). 190p. University Microfilms Order No. 74-13,148.

Thesis (Ph. D.).

The purpose is a better understanding of the nucleon–antinucleon annihilations into pions. This research was based on the experimental results of the High Energy Group of Ohio University for the reactions $\bar{p}n \rightarrow k\pi$ for k = 3, 4, 5, 6, 7, 8 at incident laboratory momentum of antiproton 3.5 GeV/c. The main research concentration on a multiperipheral Regge pole model, the CLA model, which connects the low and high energy regions in a smooth manner. This model is modified successfully in order to include the resonance formation. In general, a satisfactory fittting of the experimental and theoretical distributions is found. The Δ_δ trajectory is neglected and the exchange of the nucleon trajectory N_α only is considered. This might be the reason for different couplings found for the three isospin states of the ρ resonance. Because there is not any satisfactory formula for the amplitude phase, the partial amplitudes were added incoherently. The great number of contributing diagrams shows that the annihilation reactions are really very complex. Also the amount of resonances produced for every multiplicity was found and predictions on the shape of the Dalitz plot were verified for annihilations into three pions. (Diss. Abstr. Int., B)

19917 MESON–MESON INTERACTIONS. Petersen, J. L. (European Organization for Nuclear Research, Geneva). Acta Phys. Slovaca; 23: No. 3, 129-140(1973).

From elementary particle physics seminar; Pezinska Baba, Czechoslovakia (22 Sep 1971).

The history and the present status of theoretical and phenomenological understanding of the meson-meson scattering is briefly reviewed with emphasis on the processes $\pi\pi \rightarrow \pi\pi$, $K\pi \rightarrow K\pi$, and $\pi\pi \rightarrow K\bar{K}$. (auth)

19918 COMMENT ON THE EQUALITY $f_K = f_\pi$ IN NONLINEAR CHIRAL MODELS. Gottlieb, H. P. W. (Univ. of Adelaide). Lett. Nuovo Cim.; 10: No. 9, 399-400(29 Jun 1974).

An error in a recently derived experimental value for the ratio f_K/f_π in a nonlinear chiral model incorporating the octets of 1^+ as well as 0^- mesons, in contrast to the usual result of unity for that ratio in chiral nonlinear pseudoscalar models. It is found that there is an index-dependent coefficient, dependent on mass which just cancels out the index-mass dependence in the current to give first-order PCAC with the same pseudoscalar-meson decay constant for the whole 0^- octet. (JFP)

Strong (Baryon No. = 1)

19919 SU-3 GROUPS, RESONANCES, AND THE NEUTRON OSCILLATOR. Lewis, D. T. (University Coll. of Wales, Aberystwyth, Eng.). Lab. Pract.; 25: No. 6, 295-297(Jun 1974).

The Pi-ness, P, of a baryon is a quantum number which is numerically representative of the total number of massive pions which are lost by the particle during all the stages of its consecutive decay to the nucleon state. The mean life of the particle depends on the function (hypercharge-Pi-ness). In furtherance of the oscillator theory of baryon structure it is demonstrated that when baryons are grouped according to spin-parity criteria there is a linear relation between hypercharge and a composite function of the multiplicity and the quantum number which determines the energy of baryon vibration. (auth)

19920 SHORT RANGE CORRELATION AND DIFFRACTION IN PRODUCTION PROCESSES. Kronenfeld, R. L. Stanford, CA; Stanford University (1973). 93p. University Microfilms Order No. 74-6500.

Thesis (Ph. D.).

Two classes of theoretical models were proposed to explain multiparticle production, namely multiperipheral (or short range correlation) and diffractive (or long range correlation). The properties of each are examined in detail, and an example of each is presented which illustrates those properties. A typical short-range correlation model is the bootstrap model of inclusive reactions, which assumes that production events occur by the formation of a leading particle and a fireball, with the fireball decay distribution in its rest frame being the same as the overall distribution in the center of mass. The model is formulated in the case of particles carrying additive quantum numbers and obtain matrix integral equations for the inclusive distributions in terms of leading particle distribution functions. It is concluded that the construction of unitarized models of multiparticle production should lead to a better understanding of Regge cuts. (Diss. Abstr. Int., B)

19921 REACTION $\pi^- + p \rightarrow e^+ + e^- + n$: A POSSIBLE SOURCE OF INFORMATION ON THE NUCLEON ELECTROMAGNETIC FORM FACTORS IN THE TIMELIKE REGION. Bietti, A. (Univ., Rome); Petrarca, S. Nuovo Cim.; 22A: No. 4, 595-608(21 Aug 1974).

The reaction $\pi^- + p \rightarrow e^+ + e^- + n$ has been studied for values of the total c.m. energies ranging from 1.1 to 1.5 GeV. The "transverse" and "longitudinal" parts of the cross section have been analyzed in a particular kinematical configuration, where the neutron in the π^-–p c.m. system is at rest. This "quasi-threshold" condition has been selected in order to investigate the possibility of evaluating the nucleon form factors in the timelike region. In fact it turns out that the non-Born contributions, calculated on the basis of a simple model from pion photoproduction multipoles, do not exceed 20% of the corresponding contributions coming from the Born terms only in the energy range considered. (auth)

19922 SU_3 AND EXCHANGE DEGENERACY RELATIONS IN VECTOR-MESON PRODUCTION. Sidhu, D. P. (Rutgers State Univ., New Brunswick, NJ). Nuovo Cim.; 22A: No. 3, 357-370 (1 Aug 1974).

Experimental data on vector-meson ($\rho^0,\omega,\varphi,K^{*0}$) production in meson-baryon collision are analyzed from a phenomenological point of view. The reactions considered include both the charge exchange (Y = 0) and hypercharge exchange vector-meson production. A simple Regge-pole model with weak exchange degeneracy between a pair of natural parity, (ρ,A_2) or (K^*,K^{**}), and a pair of unnatural parity, (π,B) or (K,K_B), Regge poles is used in conjunction with SU_3 symmetry to relate various observables of vector-meson production reactions. The relations so obtained are compared with the experimental data and reasonable agreement is found both in magnitude and shape. (auth)

19923 PERIPHERAL REGGE POLE MODEL IN THE DIRECT CHANNEL. Kondo, T.; Shimizu, Y.; Sugawara, H. (Tokyo Univ., Tanashi, Japan). Progr. Theor. Phys. (Kyoto); 50: No. 6, 1916-1927(Dec 1973).

We formulate the peripheral collision in terms of the Sommerfeld–Watson transformation of direct channel partial waves. Our amplitude has many nice properties. Among other things it has a dip at constant u if the u channel is exotic although our model has nothing to do with the B-function model. The forward and the backward peak appear naturally at high energy while the lower energy amplitude shows a complicated resonance structure. We take $K^-p \rightarrow \bar{K}^0n$ as an example and obtain an excellent fit to differential cross sections over all angles in the energy region from P_L = 777 MeV to 2.25 GeV. (auth)

19924 AZIMUTHAL CORRELATIONS AND INDEPENDENT-CLUSTER EMISSION MODEL. Ranft, G. (CERN, Geneva); Ranft, J. Lett. Nuovo Cim.; 10: No. 12, 485-493(10 Jul 1974).

The independent-cluster model was applied previously to inclusive single-particle distributions, multiplicity distributions, inclusive and semi-inclusive two-particle rapidity correlations. This model is applied to the two-particle correlations in the azimuthal angle. The reactions $\pi^- + p$ and $p + p$ are considered. It is concluded that the studied model allows an understanding of the essential features of the azimuthal correlations. (JFP)

19925 πN CHARGE EXCHANGE SCATTERING AMPLITUDES AND WEIGHTED DISPERSION RELATIONS. Kanazawa, A.; Miyakoshi, T. (Hokkaido Univ., Sapporo). Lett. Nuovo Cim.; 10: No. 12, 494-498(20 Jul 1974).

An attempt is made to calculate the πN charge-exchange amplitudes by using weighted dispersion relations. Only phase shift data are used as input, while ρ-Regge forms are assumed only for the imaginary parts of helicity amplitudes at high energies. Differential cross sections and polarizations are also found. (JFP)

19926 PHENOMENOLOGICAL BOUNDS ON SIGMA-TERMS FROM POSITIVITY AND CONVENTIONAL ASYMPTOPIA. Gensini, P (Univ., Lecce, Italy). Lett. Nuovo Cim.; 10: No. 14, 585-590(3 Aug 1974).

It is shown that the sigma term can be definite positive provided the amplitude for forward elastic scattering $C_{ab}^{(+)}(q^2,\nu^2)$ has a positive-definite discontinuity and behaves not too singularly as $\nu \rightarrow \infty$. The two versions of the $(3,\bar{3}) + (\bar{3},3)$ model and the (8,8) model of symmetry breaking are considered. It is noted that the most interesting results are the bounds on the πN and Kp sigma terms. (JFP)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 20021 and 20233.

19927 (JINR-P2-7875) STRUCTURE OF INCLUSIVE PROTON SPECTRA IN THE PROTON–NUCLEUS COLLISIONS IN THE GLAUBER THEORY. Alaverdyan, G. B.; Tarasov, A. B.; Uzhinskii, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 8p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

By summing Kofoed-Hansen's series, that represent inclusive proton spectra in the proton-nucleus collisions at high energy in the intranuclear cascade model, the closed expressions for these spectra are obtained. The first one describes the proton spectra in the case, when the proton energy losses are much smaller than the incident energy. The second one corresponds to the case of large proton energy losses (much more than recoil energy of target nucleons) and is obtained by assuming the Feynman scaling for proton spectra in the nucleon-nucleon collisions. In this case inclusive proton spectra in the pA → pX collisions automatically obey scaling. By extracting the quasielastic scattering contribution, the inelastic (x < 1) pA cross section is obtained. Using this equation it is easy to connect inelasticities K and k in nucleon-nucleus and nucleon-nucleon collisions. For lead and iron targets at k = 0.5 and σ_{NN}^{abs} = 30 mb, K = 0.85 and 0.75 are found correspondingly, that is in agreement with cosmic rays data. The nonleading particle spectrum in the 1 + A → 2 + X reactions is given which is correct at least at x ≥ 0.5 when complications due to multiplicities of particles 1,2 are inessential. (auth)

19928 SPIN CORRELATION PARAMETERS FOR 50 MeV PROTON–PROTON SCATTERING. Hasegawa, T. (Kyoto Univ.). Mem. Fac. Sci., Kyoto Univ., Ser. Phys., Astrophys.; 34: No. 2, 193-212(Feb 1973).

Two kinds of measurements of the spin correlation parameters at $90^{\circ}_{C.M.}$ for the 50 MeV proton–proton scattering were performed. For the first step, the spin correlation parameters C_{KP} ($90^{\circ}_{C.M.}$) and C_{NN}($90^{\circ}_{C.M.}$) at 52 MeV were obtained by means of double scattering method, where the carbon polarimeter having nearly 40% analyzing power was used as a polarization analyzer. For the second step, the spin correlation parameters $A_{XX}(90^{\circ}_{C.M.})$ and $A_{YY}(90^{\circ}_{C.M.})$ at 47.5 MeV were measured by using polarized beam and polarized target, where the nearly 50% polarized protons were provided by p–Ca elastic scattering and the meanly 35% polarized hydrogen target was constructed by means of dynamic polarization method. The incident proton spins were frequently flipped by a spin solenoid and sometimes the target spins were inverted. Then, A_{XX} and A_{YY} were simultaneously measured by two pairs of detecting systems. The obtained results are as follows; $C_{KP}(90^{\circ}_{C.M.}: 52$ MeV) = 0.13 ± 0.11, $C_{NN}(90^{\circ}_{C.M.}: 52$ MeV) = −0.034 ± 0.095, $A_{XX}(90^{\circ}_{C.M.}: 47.5$ MeV) = −0.713 ± 0.032 and $A_{YY}(90^{\circ}_{C.M.}: 47.5$ MeV) = −0.287 ± 0.039, and also $A_{YY}/A_{XX}(90^{\circ}_{C.M.}: 47.5$ MeV) = 0.402 ± 0.057. These results are compared with the phase shift analyses and the potential model in the medium energy region. (auth)

19929 LOW ENERGY BARYON–BARYON SCATTERING IN THE TRIPLET STATE. Curiale, J. S. (Yale Univ., New Haven). Nuovo Cim.; 22A: No. 4, 527-546(21 Aug 1974).

A potential model is used to study the low-energy behavior of the two-baryon system in the $J^P = (1)^+$ state. The potential is constructed from the sum of Yukawa potentials due to the exchange of low-lying pseudoscalar and vector-meson octets. The relative coupling constants are fixed by SU_3 symmetry. The baryon pairs considered belong to the $\overline{10}$ and 8_a representations of SU_3. In addition to the meson exchange interaction a hard-core interaction in both $\overline{10}$ and 8_a states with different radii is considered. The radius of the hard core for the $\overline{10}$ representation is fixed by fitting the triplet NN scattering length. Several values of the hard core for the 8_a representations are used. They yield values for the ΛN scattering length that are within the experimental range. A singularity is found in the ΛN scattering amplitude. If one used the ansatz that SU_3 is broken only by the difference of the meson and baryon masses from their degenerate values, the motion of this singularity is studied as a function of an SU_3 symmetry breaking parameter. In this way, it is found that the pole in the ΛN amplitude which corresponds to the deuteron in the NN amplitude appears as a resonance just below the ΣN threshold. (auth)

19930 IMPACT PARAMETER ANALYSIS OF MULTIPLICITY DISTRIBUTION IN HIGH ENERGY pp COLLISIONS. Bialas, A.; Bialas, E. (CERN, Geneva). Acta Phys. Pol.; B5: No. 3, 373-383(1974).

Assuming the geometrical model of particle production, the average multiplicity of negative particles produced in high-energy proton–proton collisions at fixed impact parameter is determined from experimental multiplicity distributions and elastic scattering data. The effects of multiplicity fluctuations and two-component structure at fixed impact parameter are discussed. The results are compared with the predictions of some simple mechanisms of particle production. (auth)

19931 MULTIPLE QUARK SCATTERING PREDICTIONS FOR p–p ELASTIC SCATTERING AT NAL ENERGIES. Klenk, K. F. (Lehigh Univ., Bethlehem, PA). Lett. Nuovo Cim.; 10: No. 12, 515-520(20 Jul 1974).

The elastic-scattering cross section predictions of the quark model at NAL energies using the parameter values obtained by fitting to the Barbiellini et al. ISR data. Differential cross sections for p + p elastic are predicted. (JFP)

19932 TWO-PARTICLE CORRELATION IN THE CENTRAL REGION. Ishikawa, K. (Tohoku Univ., Sendai). Lett. Nuovo Cim.; 10: No. 12, 507-511(20 Jul 1974).

Some expressions for two-body correlations in the central region are obtained based on the multiperipheral model. The results are compared with p + p → 2π + anything interactions. (JFP)

19933 RELATIVISTIC ONE PION EXCHANGE MODEL OF PROTON–NEUTRON ELECTRON–POSITRON PAIR PRODUCTION. Peterson, W. A. Logan, UT; Utah State Univ. (1974). 145p. University Microfilms Order No. 74-13,250.

Thesis (Ph. D.).

Proton-neutron electron-positron pair production cross sections are calculated in the framework of the pseudoscalar one-pion exchange model in a fully relativistic manner. A computer program was developed to evaluate invariants and Dirac traces for a given data point. The cross sections for symmetric coplanar events for laboratory kinetic energies of 10 to 250 MeV were calculated for pair angles of 20 to 120°. Frequency distributions were also calculated, at a laboratory energy of 200 MeV, using a random number generator to select data points. The frequency distributions are illustrated by curves. It was noted that the inclusion of heavier bosons will not significantly improve the results at laboratory energies less than 200 MeV. (Diss. Abstr. Int., B)

19934 ISOBARS IN THE DEUTERON: A STUDY OF ELASTIC PION–DEUTERON BACKWARD SCATTERING. Klem, G. J. Charlottesville, VA; Univ. of Virginia (1974). 93p. University Microfilms Order No. 74-12,666.

Thesis (Ph. D.).

The elastic backscattering of pions on deuterons is used as a means to study the existence of isobars, i.e., excited states of the nucleon in the deuteron. In the medium to high energy region of ~300 to 1000 MeV, the backscattering will involve momentum transfers in the range of hundreds of MeV/c, which are too large to be supported by the predominant S-wave of the conventional deuteron wave function. Thus, at medium energies, the conventional D-state of the deuteron with an admixture probability of 6.5% in the ground state wave function will provide an ever increasing contribution as compared with the S-state contribution. It is in this energy range that isobar configurations in the deuteron will begin to compete with the conventional configurations. Because isobar masses are much larger than the nucleon mass, the wave functions will contain higher momentum components than the S- and D-waves of the conventional deuteron. Thus, despite the small admixture probability of isobar configurations in the deuteron ground state, it is expected that isobar and conventional contributions to the backscattering cross section will be comparable in the medium energy region. At higher energy the isobar contributions should dominate. The contributions from three nucleon resonances: Δ(1236), N′(1520) and N′(1535) were examined. The lightest isobar, the Δ(1236) has isospin $\frac{3}{2}$ and must appear in pairs at the isoscalar deuteron vertex. For the ΔΔ-configuration, with an admixture probability of ~1%, a contribution of 60 μb was found at 350 MeV/c incident pion laboratory momentum. (Diss. Abstr. Int., B)

Particle Invariance Principles and Symmetries

General

19935 (JINR-E2-7977) CLEBSCH–GORDAN EXPANSION FOR O(2h + 1,1). Dobrev, V.; Mack, G.; Petkova, V.; Petrova, S.; Todorov, I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 44p. Dep. NTIS (US Sales Only) $5.25.

The direct-product decomposition of two unitary representations of the supplementary series of O(2h + 1,1) is studied in detail. In-

variant bi-linear forms are written down for arbitrary symmetric tensor representations and necessary and sufficient conditions are found for their positivity. Normalized Clebsch–Gordan kernels are evaluated explicitly and the Plancherel formula is verified. The results are applied elsewhere for the diagonalization of conformal covariant dynamical equations for the Euclidean Green functions. They are related to the derivation of covariant operator product expansions. (auth)

19936 (LA-5531) DIRECT USE OF YOUNG TABLEAU ALGEBRA TO GENERATE THE CLEBSCH–GORDAN COEFFICIENTS OF SU(2). Nachamkin, J. (Los Alamos Scientific Lab., N. Mex. (USA)). Apr 1974. Contract W-7405-eng-36. 8p. Dep. NTIS $4.00.

Although it is well known that the irreducible representations of the SU(N) groups may be generated by using Young tableau algebra, this technique seems to have found little use for the derivation of closed algebraic expressions for the Clebsch–Gordan coefficients of these groups. A frontal attack on the derivation of these coefficients using tableau symmetrizers is described. For example, the SU(2) group illustrates the fundamental ideas behind the process. (auth)

19937 O(3) SHIFT OPERATORS AND THE GROUP SL(3,R). Hughes, J. W. B. (Queen Mary Coll., London). J. Phys., A (London); 7: No. 7, 779-786(1 May 1974).

A preliminary analysis of irreducible unitary representations of SL(3,R) is given using O(3) shift operator techniques similar to those used for treating SU(3) in an O(3) basis. A full analysis is given of the $\Delta\iota = 2$ representations, for which minimum ι of 0, ½ and 1 are found, but not the $\iota_{min} = 3/2$ representations proposed by Biedenharn et al. (Phys. Lett.; 42B: 257-60(1972)). (auth)

19938 LIE GROUPS, LIE ALGEBRAS, AND THEIR REPRESENTATIONS. Varadarajan, V. S. Prentice-Hall Series in Modern Analysis. Enclewood Cliffs, NJ; Prentice-Hall, Inc. (1974). 441p. $19.95.

The topics cover differentiable and analytic manifolds, Lie groups and algebras, structure theory, and complex semisimple Lie algebras and groups: structure and representation. (JFP)

19939 CLASSICAL GROUPS FOR PHYSICISTS. Wybourne, B. G. New York; John Wiley and Sons, Inc. (1974). 426p. $19.95.

The topics discussed include symmetry and quantum numbers, groups composed of regular matrices, local properties of Lie groups, Lie groups and Lie algebras, root vectors and the classical Lie algebras, simple roots and Dynkin diagrams, the chevelley basis, representations of Lie groups and Lie algebras, weights and the labeling of irreducible representations, Kronecker products, representations, weights, and labeling, and the exceptional groups. Also the exceptional groups, dimensions of irreducible representations, the Casimir invariants, some global properties of Lie groups, representations of some three-parameter Lie groups, some SU(1,1)-type spectrum-generating algebras, the Wigner–Eckart theorem and tensor operators are treated. Case studies of the isotropic harmonic oscillator, the hydrogen atom, and fermions and shell structure are considered. (JFP)

Applications (Electromagnetic and Weak)

19940 (RCN-203, pp 20-56) SEARCH FOR SPATIAL PARITY NONCONSERVATION AND TIME REVERSAL VIOLATION IN NUCLEAR INTERACTIONS WITH POLARIZED NEUTRONS. Kruchitskii, P. A. (Inst. of Theoretical and Experimental Physics, Moscow). Dec 1973. (In Russian).

From nuclear physics with thermal and resonance energy neutrons; Petten, Netherlands (22 May 1973).

The theory and experiments related to the search for spatial parity nonconservation and time invariance violations in nuclear γ transitions performed with polarized neutron beams are reviewed. Theoretical estimates of the expected effects and the experiment classification are given. The experiments described, performed in the Institute for Theoretical and Experimental Physics (ITEP, Moscow), resulted in the discovery that the weak nucleon–nucleon interaction does not conserve spatial parity. The ITEP experiments which set the upper limit for the strength of the T-noninvariant interaction are also described. The results obtained in ITEP are compared with those obtained in other institutes. (6 figures, 2 tables) (auth)

19941 BOOTSTRAP EQUATIONS WITH RESTRICTED SU(3) SYMMETRY AND THE CABIBBO ANGLE. Campbell, J. A. (CERN, Geneva); Green, H. S.; Leipnik, R. B. Phys. Rev., D; 9: No. 8, 2451-2455(15 Apr 1974).

The bootstrap equations $v_i = cd_{ijk}(v_j v_k + a_j a_k) + V_i$, $a_i = \frac{1}{2} cd_{ijk}(a_j v_k + v_j a_k) + A_i$ for vector (v) and axial-vector octet matrix elements, where V and A are driving terms, are studied. It is concluded that the equations in their most general form always have solutions with at least two free parameters, so that they may not be used to make unique physical predictions. The need for completeness of sums over repeated indices is questioned. As an example of what happens when the condition of completeness is relaxed, the equations exclusive of terms which represent weak neutral currents, and with no driving terms, are solved to give a Cabibbo angle which is 0.28 without adjustable parameters. (auth)

Applications (Strong)

19942 GAUGE THEORIES OF STRONG INTERACTIONS, SPECTRAL-FUNCTION SUM RULES, AND CHIRAL-SYMMETRY BREAKING. Mohapatra, R. N. (Univ. of Maryland, College Park). Phys. Rev., D; 9: No. 8, 2355-2364(15 Apr 1974).

Using the explicit form of the strong-interaction Hamiltonian provided by a certain class of gauge theories, and the technique of the Bjorken–Johnson–Low expansion, sum rules relating the vector, axial-vector, scalar, and pseudoscalar spectral functions and the chiral-symmetry-breaking parameters are derived. Consistency of the sum rules in the pseudoscalar-(PS) meson sector demands that there should be a heavy nonet of PS mesons. It is shown that the nature of chiral-symmetry breaking depends on the character of these heavy mesons. The two modes of symmetry breaking resulting from this are studied. Using the assumption of pole dominance for the spectral functions, the chiral-symmetry-breaking parameters are evaluated in one case. Also decay widths of ρ, ω, and ϕ mesons to lepton pairs are evaluated. (auth)

19943 QUARTET KAON THEORY IN O(4) SYMMETRY AND CP LAW. I. Mawatari, H. (National Lab. for High Energy Physics, Oho, Japan); Nakamura, S.; Nakazawa, N.; Sato, S. Progr. Theor. Phys. (Kyoto); 50: No. 6, 1981-1999(Dec 1973).

On the basis of the O(4) symmetry, a quartet kaon (K^+, K^0, L^0, L^-) and its charge-conjugate multiplet (L^+, $-L^0$, $-\bar{K}^0$, K^-) are deduced. One starts by assuming the mass degeneracy of the four components with regard to the strong interactions and two kinds of the mixture states are obtained by introducing in the O(4) space the respective two kinds of the weak interactions, one being symmetric and the other symmetry violating. One could thus find a solution which enables one to account for the strangeness oscillation, charge asymmetry of K_{l3} decays of the neutral kaon and the beat phenomena of the 2π decays without assuming the CP violation. However, in this solution, $r \equiv (K_S \to 2\pi)/(K^0 \to \text{all})$ coming from K^0 produced by $\pi^- p \to K^0 \Lambda$ should be 1/4. (auth)

19944 GROUP THEORETICAL STRUCTURE OF HADRON MASS SPECTRA IN SU(2) × SU(2) DYNAMICS. Noga, M.; Nagy, P. (Komenskeho Univerzita, Bratislava). Acta Phys. Slovaca; 23: No. 3, 158-167(1973).

The Weinberg algebraic realization of the chiral SU(2) ⊗ SU(2) symmetry is considered for a case when only s-wave and p-wave pions are taken into account. Under the generally accepted assumption of the absence of exotic states, the mass spectrum operator of hadrons is proved to behave as a sum of scalar and a component of a 35-dimensional totally antisymmetric third-rank tensor of the group SO(7). (auth)

Scattering Theory

Refer also to abstracts 19909, 20268, and 20306.

19945 (RL-74-38, pp Paper 5) INTRODUCTION OF ANALYTICITY INTO PHYSICS. Jones, G. T. (European Organization for Nuclear Research, Geneva). 1973.

From school for young high energy physicists; Chilton, UK (15 Jul 1973).

The aim of the course is to discuss ideas which lead from quantum mechanics to S-matrix theory. The subject is dealt with under the following headings: analytic functions; laws of physics–differential equations; coulomb scattering; particles are poles in the scattering amplitude; real analyticity; the singularities of analytic function; the relation of relativity to quantum mechanics; limits of measurement; S-matrix theory; Hall-Wightmann theorem; crossing; cuts in the relativistic scattering amplitude. (UK)

19946 STRENGTH OF THE G-MATRIX CONDITION IN THE REDUCED-DENSITY-MATRIX VARIATIONAL PRINCIPLE.

Kijewski, L. J. (Monmouth Coll., West Long Branch, NJ). Phys. Rev., A; 9: No. 6, 2263-2266(Jun 1974).

A test is made of the strength of the G-matrix condition and of the practicality of such numerical calculations. Results obtained show great improvement over previous results. (auth)

19947 REGGE LATTICE AND LIE-ALGEBRA REPRESENTATIONS. Flato, M.; Snellman, H. (Physique Mathematique Coll., Paris). J. Math. Phys. (N.Y.); 15: No. 6, 857-860(Jun 1974).

A possible description of Regge trajectories in terms of an irreducible representation of the Lie algebra of the 11-parameter Weyl group is proposed. (auth)

19948 J-PLANE ANALYSIS OF THE VENEZIONO AMPLITUDE WITH NONLINEAR TRAJECTORIES. Bugrii, A. I.; Enkovskii, L. L.; Kobylinskii, N. A. (Inst. of Theoretical Physics, Kiev). Ann. Phys. (Leipzig); 31: No. 1, 83-100(1974).

The structure of singularities of the Veneziano amplitude in the complex angular momentum plane is studied. The introduction of a nonlinear term in the trajectory essentially changes the properties of the partial amplitude as compared to the case of linear trajectories. In the J-plane, besides simple poles lying on the leading and on the conventional daughter trajectories, additional poles lying on mirage trajectories (situated below the leading trajectory) emerge. In the partial amplitude also non-Reggeised poles in the s-plane emerge whose position is independent of the angular momentum. Such are, for example, the ancestors. (auth)

19949 GRAPHICAL REPRESENTATION FOR INTERPRETING SCALAR WAVE MULTIPLE-SCATTERING PHENOMENA. Howarth, B. A.; Pavlasek, T. J. F.; Silvester, P. (McGill Univ., Montreal). J. Comput. Phys.; 15: No. 2, 266-285(Jun 1974).

A graphical method of presenting numerical results relating to two-dimensional wave scattering by multiple obstacles is described. It is particularly suited to reducing computed scattered wave multipole values to a curve which may be readily interpreted. By suppressing single-scattering (isolated body) phenomena the method displays only those effects which arise from multiply-scattered waves. The technique is applied to interpret data obtained from a computational study of TM-wave scattering by two 1.0-λ-diameter conducting cylinders, and conclusions derived from these curves are shown to agree with results presented in more conventional form, elsewhere. The method is also used to interpret the results of studies on planar three cylinder arrays, including investigation of TM and TE illumination of conducting cylinders and also scattering by dielectric cylinders. The graphs described require less effort in their preparation than alternative presentations, and are of great value in assessing whether the results of a numerical investigation represent novel multiple-scattering behavior, without the necessity of plotting the field intensity contours. In this sense the method provides a bridge between computer experiments and physical insight. It is also suggested that it may be possible to use these curves for the quantitative as well as the qualitative description of multiple-scattering effects. (auth)

19950 NUMERICAL SOLUTION OF A SINGULAR INTEGRAL EQUATION IN RANDOM ROUGH SURFACE SCATTERING THEORY. DeSanto, J. A.; Shisha, O. (Naval Research Lab., Washington, DC). J. Comput. Phys.; 15: No. 2, 286-292(Jun 1974).

A one-dimensional singular integral equation which appeared in a previous paper on random rough surface scattering theory (J. Math. Phys., 13: 1903(1972)) is solved numerically using quadratic splines. Its solution yields an approximation to the coherent (specular) scattered intensity for plane wave incidence on the surface. This approximate scattered intensity is plotted versus the Rayleigh factor $\Sigma = k_0 \sigma \cos \theta_i$, where k_0 is the wave number of the incident plane wave, σ is the surface root mean square height, and θ_i is the angle of the incident plane wave. For values of $\Sigma > 1$ this approximation yields more coherent intensity than the Kirchhoff approximation. (auth)

19951 QUESTION OF THE VALIDITY OF THE EIKONAL APPROXIMATION. Banerjee, H.; Malik, S. (Saha Inst. of Nuclear Physics, Calcutta). Phys. Rev., D; 9: No. 4, 956-962 (15 Feb 1974).

We examine the question of whether, in the scalar-scalar theory, the eikonal approximation reproduces in each order of perturbation the high-energy behavior of the sum of amplitudes for generalized ladder diagrams with scalar-meson exchanges. In the eighth order, which marks the onset of noneikonal asymptotic contributions, one need study for this purpose only seven distinct diagrams, and we derive the asymptotically leading terms of the absorptive parts of the amplitudes for these diagrams. The amplitudes of two of these diagrams show an enhanced behavior $(\ln^3 s)/s^3$ essentially because of the existence of pinch in the coefficient of s. The leading terms of these dominant diagrams, however, cancel and we show that the sum of contributions from all the diagrams behaves asymptotically as $(\ln s)/s^3$ in contradiction with the $1/s^3$ behavior dictated by the eikonal approximation. In the ϕ^3 theory, however, because of the identity of the exchanged meson with the incident ones, the two dominant diagrams get an extra weight factor of ½ relative to the remaining diagrams and this leads to the complete cancellation of the $(\ln s)/s^3$ terms in the sum. Thus the question of validity of the eikonal approximation in the ϕ^3 theory is still open. (auth)

19952 MULTIPARTICLE PARTIAL-WAVE AMPLITUDES AND INELASTIC UNITARITY. IV. A Scattering Model With Production and Its Characteristic Operator Function. Klink, W. H.; Johnson, L. E. (Univ. of Iowa, Iowa City). Phys. Rev., D; No. 4, 1057-1064(15 Feb 1974).

A completely solvable quantum-mechanical three-particle system that includes breakup is discussed. The partial-wave amplitudes obtained are written in an abstract form to remove their dependence on potential theory, and unitarity is then used to specify genuine production amplitudes. The characteristic operator function is calculated for the resulting set of partial-wave amplitudes, as a physical illustration of the harmonic-analyses approach to three-body unitarity. (auth)

19953 NONUNIFORMITY OF THE ADLER SUM RULE IN THE DEEP-INELASTIC REGION. Genova, J. (State Univ. of New York, Stony Brook). Phys. Rev., D; 9: No. 4, 1065-1073 (15 Feb 1974).

A possible nonuniformity of the Adler sum rules of the form discussed by Cornwall, Corrigan, and Norton, $\int_0^\infty (d\omega/\omega) \nu W_2(q^2,\nu) = 1$, q^2 fixed, and $\int_0^\infty (d\omega/\omega) \lim_{\nu\to\infty;\omega=-q^2/2\nu} \nu W_2(q^2,\nu) = C'$ is discussed. The sum rules are evaluated in φ^3 perturbation theory and by using light-cone techniques. It is seen that the possible nonuniformity ($C' \neq 1$) of the sum rule follows from the assumption of a point-like form factor. That is, if the hadron need not dissociate prior to interacting with the current, then C′ will not equal 1. (auth)

19954 HIGHER-ORDER CALCULATION OF TRANSMISSION ABOVE THE POTENTIAL BARRIER. Wald, S. S.; Lu, P. (Arizona State Univ., Tempe). Phys. Rev., D; 9: No. 4, 895-898 15 Feb 1974).

By extending the Miller-Good modified WKB approximation to include the higher-order terms, as derived by Lu and Measure, we are able to calculate the transmission coefficients for energies above the potential barrier. We show that the higher-order terms are essential to the approximation, especially for energies near the barrier top. (auth)

19955 ANALYTICITY AND NOISE IN THE NUMERICAL ANALYTIC CONTINUATION OF SCATTERING DATA. Viano, G. A. (Univ., Genoa). Lett. Nuovo Cim.; 10: No. 14, 591-597 (3 Aug 1974).

The discussion of analyticity and noise in the numerical analytic continuation of scattering data includes the geometry of the unit disc Ω in the complex z-plane. It is investigated how it is possible to get stability for the solutions in the case considered. (JFP)

19956 SHIELDING-CUT MECHANISM FOR THE GREY-DISC POMERON OF BALL AND ZACHARIASEN TYPE. Fujisaki, H. (Rikkyo Univ., Tokyo). Lett. Nuovo Cim.; 10: No. 12, 504-506(20 Jul 1974).

An indefinitely growing total cross section and asymptotically vanishing triple-pomeron vertex is assumed. One is then led to the possibility of the self-considered multiperipheralism of Ball and Zachariasen type, which yields the self-reproducing colliding-branch cut pomeron of strong cut strength. But this solution is inconsistent with t-channel unitarity. It is, therefore, considered whether or not there is any appropriate shielding-cut mechanism of the Oehme type for the grey-disc pomeron. A generating mechanism of shielding cuts is proposed in order to make the grey-disc pomeron compatible with t-channel unitarity. (JFP)

19957 RELATIVISTIC HADRON DYNAMICS: A PRESENTATION OF SOME MODELS FOR THE RELATIVISTIC S-MATRIX. Milgram, M. S. Toronto; Univ. of Toronto (1971). 92p.

Thesis.

The discussion covers a brief introduction to the principles of S-matrix theory; some of the recent advances of Veneziano and others and how the author's work fits into this setting; some post publication advances in the author's models; and contributions insofar as the experimental analysis of $\pi^- p \to \pi^- p\omega$ at 6.9 GeV/c is concerned. Technical details of the model and useful formulas are given. (auth)

19958 EQUIVALENCE BETWEEN FADEEV-LIKE EQUATIONS AND A SET OF LIPPMANN-SCHWINGER EQUATIONS

FOR THREE-BODY TRANSITIONS OPERATORS. Vanzani, V. (Univ., Padua). Lett. Nuovo Cim.; 10: No. 14, 610-614(3 Aug 1974).

A generalized Lippmann–Schwinger formulation is provided in terms of transition operators. Also some properties of the set of Lippmann–Schwinger equations for both scattering states and transition operators are investigated, and an attempt is made to clarify the connection between the Faddeev-like and the Lippmann–Schwinger-like approaches. (JFP)

19959 ANALYTICAL STUDIES IN SCATTERING BY NON-LOCAL SEPARABLE POTENTIALS. Shastry, C. S.; Singh, M. (Birla Inst. of Tech. and Science, Pilani, India). Progr. Theor. Phys. (Kyoto); 51: No. 1, 193-204(Jan 1974).

The question of existence of unique and square integrable solutions of the Lippmann–Schwinger equation is examined for a class of separable non-local potentials. A simple procedure is given to obtain the equivalent potentials. The behavior of the scattering wave function for the non-local separable potentials is compared with the same for a class of local potentials. The S-matrix is constructed for non-local separable potentials with Yukawa and Gaussian type r(r') dependence and their properties are investigated in both momentum (k) and angular momentum (l) planes. It is found that important analytical properties of the S-matrix for these non-local potentials are similar to those obtained in the case of corresponding local potentials, namely Yukawa and Gaussian potentials. (auth)

19960 NONRELATIVISTIC HIGH ENERGY SCATTERING ON SINGULAR POTENTIALS. Dolinszky, T. (Instituto Nazionale di Fisica Nucleare, Rome). Nuovo Cim.; 22A: No. 4, 578–594 (21 Aug 1974).

The scattering problem for a potential of singularity r^{-4} is solved in terms of the phase function. The high-energy phase shift was found to depend, to a high accuracy, linearly on the symmetry parameter χ of the pure power potentials and the proportionality factor turned out to support the asymptotic exactness of the WKB approximation. Some formulae for the small-distance behavior of the phase function are also given. (auth)

19961 STEADY-STATE VALUES OF THE DIFFERENTIAL CROSS SECTION AND OF OVERLAPPING FUNCTIONS AT HIGH TEMPERATURES. Azimov, S. A.; Arushanov, G. G.; Pirmatov, I. I. (Tashkent State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 73-79(1973). (In Russian).

Previously obtained extremal values for the differential, elastic scattering cross section in the region of the diffraction cone are generalized to the case of other angles, and are presented in a form suitable for comparison with experimental data. Analogous results were also found in the case of binary inelastic reactions and of overlapping functions. Comparison with experimental data shows that the steady-state values are close to the measured values. (SJR)

19962 TWO-CHANNEL S-MATRIX IN THE QUASI-CLASSICAL APPROXIMATION. Dubrovskii, G. V.; Fischer-Hjalmars, I. (Univ., Stockholm). J. Phys., B (London); 7: No. 8, 892-910 (1 Jun 1974).

The curve-crossing problem in slow collisions was considered within the consistent quasi-classical approximation. The two-channel S-matrix was found for two levels intersecting either with similar or different slopes. A consistent use of the WKB method (Zwaan-Stueckelberg's technique and parabolic cylinder function method) made it possible both to write the final results in a general form suitable for applications to realistic potential curves and to find the additional phase arising from a non-adiabatic transition. The results obtained can be used to describe different quantum effects in many-channel scattering and for calculation of predissociation spectra. (auth)

19963 ASYMPTOTIC BEHAVIOR AT EXCEPTIONAL MOMENTA. Thun, H. J. (2 Feb 1974). 67p. INIS.

3 figs.; 39 refs.; With app. With abstract.

Diss. (D. Sc.).

A method is developed for investigating the asymptotic behavior of vertex functions at certain Minkowskian exceptional momenta. It is a direct generalization of earlier treatments of Euclidean exceptional momenta. It makes use of formal expansions in momentum space, closely related to light cone expansions in position space. The expansions have to be performed in those channels which carry finite total momentum squared and admit (in A^4-theory) two-particle intermediate states. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

19964 SUPERFLUIDITY OF THIN ^{4}He FILMS. Chan, M. H. Ithaca, NY; Cornell Univ. (1974). 135p. University Microfilms Order No. 74-13,748.

Thesis (Ph. D.).

Superfluid persistent currents in thin ^{4}He films have been studied at temperatures down to 0.2K using a gyroscopic technique. It was found that on a bare Vycor glass substrate no superflow is possible for ^{4}He films less than two atomic layers. It was also found that at a sufficiently low temperature all ^{4}He atoms above this critical coverage participate in the superflow. The critical coverage necessary to support superflow is reduced when the porous glass is preplated with one layer of neon. For superfluid films on both substrates, the temperature at which dissipation sets in was found to increase linearly with the ^{4}He film thickness. The dissipation process is studied by measuring the critical velocity of the superflow as a function of temperature as well as film thickness. It is shown that the dissipation process can be attributed to the creation of vortex line pairs. (Diss. Abstr. Int., B)

19965 CRYOGENIC SYSTEM FOR STUDYING THE PROPERTIES OF ^{3}He BETWEEN 1 AND 15 mK. Alvesalo, T. A.; Anufriyev, Y. D.; Lund, P. B.; Collan, H. F.; Loponen, M. T. (Helsinki Univ. of Tech., Otaniemi, Finland). Cryogenics; 14: No. 7, 384-390(Jul 1974).

A cryogenic system for studying the properties of ^{3}He between 1 and 15 mK is described. The apparatus has been utilized for measurement of viscosity and heat capacity of liquid ^{3}He along the melting curve. ^{3}He is refrigerated in two steps. For temperature down to about 15 mK a rather powerful dilution refrigerator, with a circulation rate of 70 μmoles s^{-1}, is used. This machine has sintered copper heat exchangers of novel design. Below 15 mK ^{3}He is self-cooled through adiabatic compression of a liquid/solid mixture (Pomeranchuk's method). A description of constructional details and performance characteristics of the dilution refrigerator and the compressional cooling cell is given. Some aspects of thermometry are also discussed. (auth)

19966 ATTENUATION OF PHONONS IN LIQUID HELIUM AT VERY LOW TEMPERATURES. Sluckin, T. J.; Bowley, R. M. (Nottingham Univ., Eng.). J. Phys., C (London); 7: No. 10, 1779-1785(21 May 1974).

A theory is developed to describe the attenuation of high-frequency phonons in liquid helium at low temperatures, assuming a model excitation spectrum due to Jäckle and Kehr (Phys. Rev. Lett.; 26:654 (1971)). At very low temperatures the attenuation is negligible when the dispersion is normal, but significant when dispersion is anomalous. The recent measurements of Narayanamurti et al (Phys. Rev. Lett.; 31:687(1973)) are interpreted as the decay of a broadband phonon system. (auth)

Superconductivity

Refer also to abstracts 19297, 19397, and 20168.

19967 SUPERCONDUCTIVITY DESTRUCTION IN TIN OF DIFFERENT PURITY BY A CURRENT. Sulkowski, C.; Mazur, J. (Inst. of Low Temperatures and Structure Research, Wroclaw). Acta Phys. Pol.; A45: No. 6, 869-872(Jun 1974).

The results of superconductivity destruction by current in tin of various purities are reported and compared with London's theory of the intermediate state. (auth)

19968 SUPERCONDUCTOR FLUCTUATIONS ABOVE TRANSITION IN A MAGNETIC FIELD. Shenoy, S. R. New Haven; Yale Univ. (1973). 158p. University Microfilms Order No. 74-12,491.

Thesis (Ph. D.).

The effect of a magnetic field on order parameter fluctuations in superconductors above their second-order transition temperatures is considered. The fluctuation-induced specific heat for a bulk Type-II superconductor is calculated in a nonzero field H, just above the transition temperature $T_c = T_{c2}$ (H) but outside the critical region. In the Ginzburg-Landau (GL) approximation it is found that close enough to transition the specific heat is enhanced, with the temperature dependence changing from bulk behavior $\sim (T-T_c)^{-\frac{1}{2}}$ (familiar near $T_c = T_{co}$ in the bulk zero field case) to a one-dimensional form $\sim (T-T_c)^{-\frac{1}{2}}$. This change in effective dimensionality is accompanied by an expansion of the critical region. For the clean bulk case, the results of Lee and Payne, and of Kurkijärvi, Ambegaokar and Eilenberger are rederived for the thermodynamic potential that includes the higher order field terms neglected by the GL approximation. Using this potential for the specific heat, our enhancement result is found to be unchanged; it is also found that (unlike the fluctuation diamagnetism) the specific heat is not anomalously sensitive to the field. A proposal of Scalapino that the order parameter correlation function can be probed by a magnetic field is examined. He considers the fluctuation-induced pair tunneling current through a junction composed of two superconductors separated by an insulator (I) with one side (S) above, the other (F) just below, its transition temperature, and shows phenomenologically that a magnetic field H parallel to I picks out one momentum component $\hbar q_s \propto H$ of the correlation function in F, on which the current directly depends. This momentum selection is verified microscopically in the GL approximation, and a further field dependence of the current coming from the lowering of the transition temperature, T_c (H), is found. In the weak field regime to which his calculation is restricted with pair fluctuation states uniform across F, both sources $q_s \propto H$ and T_c (H) give the same field dependence of the current; this restriction is relaxed and it is found that for thick and dirty films on the F side, the GL approximation remains valid even in the strong field regime of spatially varying states, where the two field dependences can be distinguished. Measurements of these deviations from phenomenological predictions would then confirm the idea that the correlation function can be probed by a field. (Diss. Abstr. Int., B)

19969 ELECTRON THERMAL CONDUCTIVITY OF THIN SUPERCONDUCTING FILMS IN METALLIC CONTACT: THE PROXIMITY EFFECT. Migliori, A. Urbana, IL; Univ. of Illinois (1973). 97p. University Microfilms Order No. 74-12,109.

Thesis (Ph. D.).

A proximity effect sample was produced by evaporating a layer of indium and then a layer of thallium onto an insulating substrate cooled to 3K. The thermal conductivity, electrical resistivity, transition temperature, and thickness of the resulting sandwich and of each of its components were measured for various thicknesses of indium and thallium. The measured transition temperatures for the sandwich were compared to those predicted by the theory of Fulde and Moorman with no adjustable parameters. The agreement was only moderately good. Since there is no theory which treats the thermal conductivity of such a sandwich, an effective-gap-parameter model was developed from the theory of Bardeen, Rickayzen and Tewordt, and combined with the theory of Fulde and Moorman. The experimental results were compared to those predicted by the model and good agreement found. (Diss. Abstr. Int., B)

19970 SUPERCONDUCTIVITY AT THE SURFACE OF LEAD TELLURIDE. Miller, D. L. Urbana, IL; Univ. of Illinois (1973). 103p. University Microfilms Order No. 74-12,114.

Thesis (Ph. D.).

Ultrathin films of the metals Pb, In, Tl, Sn, and Al were deposited on crystalline PbTe substrates in an attempt to fabricate a system favorable for the observation of an excitonic mechanism of superconductivity. For each of these metals, superconductivity was observed at the PbTe surface. A threshold amount of metal deposited was necessary for superconductivity, and the observed transition temperatures increased as the amount of metal deposited increased beyond the threshold amount. Maximum values of the observed T_c's at thicknesses less than 100 Å were 6.75°K for In, about 5.25°K for Tl, 7.15°K for Pb, 3.4°K for Sn, and 2.6°K for Al. The PbTe substrate surface and the metal overgrowth were characterized by the use of low energy electron diffraction and Auger electron spectroscopy. The substrates were cooled to 100°K during the metal evaporation and it was found that crystalline epitaxial films of Pb, In, and Tl could be grown at this temperature. The data indicate, however, that the metal film agglomerated by the time the superconducting properties were measured, due to the necessity to warm the sample to room temperature to transfer it from the vacuum system in which it was prepared. Critical temperatures, critical fields, and critical currents are presented, and several models to explain the superconductivity are discussed. The existence of superconductivity in a continuous thin film on the sample surface, or in the PbTe due to electronic doping of the surface, are not consistent with the observed data. Superconductivity in a mesh of metal or metal alloy on the surface, superconductivity in an n-type inversion region at the PbTe surface, or a combination of the two models are not conclusively eliminated by the data. Little can be concluded about the existence of excitonic superconductivity in this sytem, since a configuration favorable for this mechanism has not been achieved. Suggestions for future experiments are given. (Diss. Abstr. Int., B)

19971 FIRST-ORDER PHASE TRANSITIONS IN SUPERCONDUCTORS AND SMECTIC-A LIQUID CRYSTALS. Halperin, B. I. (Bell Labs., Murray Hill, NJ); Lubensky, T. C.; Ma, Shang-keng. Phys. Rev. Lett.; 32: No. 6, 292-294(11 Feb 1974).

The superconducting phase transition is predicted to be weakly first order, because of effects of the intrinsic fluctuating magnetic field, according to a Wilson-Fisher ϵ-expansion analysis, as well as a generalized mean-field calculation appropriate to a type-I superconductor. Similar results hold for the phase transition from a smectic-A to a nematic liquid crystal. (auth)

19972 ACTION PRINCIPLE FOR SUPERCONDUCTIVITY. Chela-Flores, J. (Instituto Venezolano de Investigaciones Cientificas, Caracas). J. Math. Phys. (N. Y.); 15: No. 5, 547-551 (May 1974).

A Lagrangian theory of superconductivity is studied which, for slowly varying field variables, is shown to be equivalent to the BCS theory; the conservation of pairs is obtained, clearly showing its relation with the second kind of gauge invariance of the Euler-Lagrange equations. Finally, by treating the gauge function as a further field variable, the Maxwell-type Ginzburg-Landau equation is studied, and used to discuss flux quantization. (auth)

19973 MIXED STATE ULTRASONIC ATTENUATION IN CLEAN NIOBIUM NEAR H_{c2}. Purvis, M. K.; Johnson, R. A.; Hoffman, A. R. (Massachusetts Univ., Amherst). J. Phys. Chem. Solids; 35: No. 8, 989-997(Aug 1974).

Both longitudinal and shear ultrasonic attenuations and magnetization were measured as a function of magnetic field in the mixed state of two niobium single crystal samples with residual resistivity ratios of 68 and 2665 respectively. Particular attention was paid to the behavior of the attenuation at fields near H_{c2}. The higher purity sample showed marked frequency dependence of normalized attenuation at frequencies from 10 to 110 MHz. The other sample showed qualitatively similar but less pronounced frequency dependence at frequencies ranging from 10 to 435 MHz. Frequency dependence in both samples was in qualitative agreement with the theoretical results of Cerdeira and Houghton (Phys. Rev.; B3:2997 (1971)). The attenuation changes near H_{c2} at the lowest experimental frequencies were compared quantitatively with the frequency independent theoretical results of Houghton and Maki (Phys. Rev.; B4:843 (1971)). Agreement in the less pure sample was within a factor of two of the Houghton-Maki results at both 4.2 and 1.4 K. Quantitative comparison to theory for the purer sample must be qualified by the large observed frequency dependence. However, agreement between theory and experiment was excellent at 4.2 K. At 1.4 K in the purer sample, the theoretical predictions differed from experimental results by factors from two to six for various configurations of magnetic field and ultrasonic propagation and polarization directions. Houghton-Maki predictions of the dependence of ultrasonic attenuation on the geometry of magnetic field and ultrasonic propagation and polarization direction were also examined. (auth)

19974 LOW TEMPERATURE HEAT-CAPACITY MEASUREMENTS OF V_3Ga AND Nb_3Al. Viswanathan, R.; Wu, C. T.; Luo, H. L.; Webb, G. W. (California Univ., La Jolla). Solid State Commun.; 14: No. 11, 1051-1054(1 Jun 1974).

By low temperature heat capacity measurements using the ac technique, it is shown indirectly that martensitic transformations do occur in V_3Ga and Nb_3Al. (auth)

19975 ZERO TEMPERATURE ENERGY GAP OF STRONG COUPLING SUPERCONDUCTORS. Leavens, C. R. (National Research Council, Attawa, Can.). Solid State Commun.; 14: No. 11, 1189-1193(1 Jun 1974).

A simple equation for the zero temperature energy gap of a superconductor is derived which enables one to calculate Δ_0 very quickly with only a modest loss of accuracy. This equation is used to calculate the relative effectiveness of phonons of different frequencies in enhancing Δ_0. It predicts that the optimum phonon frequency for enhancing Δ_0 is close to Δ_0 for any material. (auth)

19976 TEMPERATURE DEPENDENCE OF K_c FOR TYPE-II SUPERCONDUCTORS. Mancini, F.; Umezawa, H.; Vitiello, G. (Salerno Univ., Italy). Solid State Commun.; 14: No. 11, 1123-1125(1 Jun 1974).

The temperature dependence of the critical value K_c of the Ginzburg-Landau parameter which separated type-II/1 from type-II/2 superconductors is theoretically computed by means of a microscope calculation of the boson characteristic function at nonzero temperature, assuming that the temperature is not too close to T_c. Agreement with experimental data is satisfactory in the region $0 \leq T/T_c \leq 0.6$. (auth)

19977 ULTRASONIC ATTENUATION IN THE INTERMEDIATE STATE OF INDIUM. Mahajan, S. K.; Chaudhuri, K. D. (Delhi Univ., India). Solid State Commun.; 14: No. 11, 1083-1086(1 Jun 1974).

Ultrasonic attenuation was measured in the intermediate state of high purity single crystals of indium of different sizes over the frequency range 10 to 30 MHz. Oscillations in the temperature dependence of attenuation of longitudinal ultrasound have been observed and are discussed here in the light of a recent theory. (auth)

19978 HIGHER CRITICAL CURRENT DENSITY IN SUPERCONDUCTING V_3Ga COMPOSITE WIRES. Howe, D. G.; Weinman, L. S.; Meussner, R. A. (Naval Research Lab., Washington, DC). Cryogenics; 14: No. 7, 412-414(Jul 1974).

V_3Ga wire has been produced with a critical density of 10^6 A cm^{-2} in 100 kG fields. Critical current (J_c) data are presented. These show a large increase in J_c as the Ga concentrations in the alloys of the composite wire are increased. These J_c data for short samples illustrate the effects of alloy composition and processing on the resulting V_3Ga reaction layer. The J_c of 10^6 A cm^{-2} at 100 kG should have technological impact for magnets in the range 100 kG and above. (UK)

19979 PINNING OF VORTICES IN SUPERCONDUCTING NbTa ALLOYS DUE TO NORMAL CONDUCTING PRECIPITATES. Antesberger, G.; Ullmaier, H. (Kernforschungsanlage, Juelich, Ger.). Phil. Mag.; 29: No. 5, 1101-1124(May 1974).

Measurements of pinning forces in a system with a well-defined metallurgical structure which allows a determination of the interaction force K_0 between a single flux line and a single defect have been made. It could be shown that the absolute values of K_0 and their temperature dependence are in good agreement with theoretical values from the core pinning interaction. This indicates that in this system the gain in condensation energy during the entry of a flux line core into a normal conducting volume is the dominant cause for pinning. Typical values for the maximum interaction force K_0 and the corresponding interaction energy are $K_0 \simeq 2.5 \times 10^{-11}$ N and $\phi \simeq 2.7$ eV, respectively, for T = 4.2 K and low flux densities. Additional flux creep experiments qualitatively confirm the results obtained from the quasistatic pinning force measurements. (auth)

19980 STUDY OF CONSTITUTIONAL EQUILIBRIUM IN NIOBIUM ZIRCONIUM ALLOYS, USING THE SUPERCONDUCTING TEMPERATURE TRANSITION. Milne, I.; Finlayson, T. R. Phil. Mag.; 29: No. 5, 965-981(May 1974).

The superconducting transition temperatures of various Nb-Zr alloys heat treated from 500° to 1050°C were used to determine the limit of solid solubility of Zr in Nb. It was found that a variation of oxygen concentration between 80 and 480 p.p.m. had no influence on the Zr solubility limit, nor on the transition temperature of the solid solution. The solubility limit thus determined was of the same form as that determined by Rogers and Atkins (Rogers, B. A. and Atkins, D. F., 1955, J. Metals, 7, 1034) but at lower Zr concentrations. Constitutional equilibrium was reliably established only in specimens annealed for one week and then only in those alloys where there was a high degree of supersaturation of the Nb-Zr solid solution, despite all the alloys being deformed beyond 80%. Evidence in the nature of a proximity effect showed that after annealing for 4 hours between 800° and 900°C undeveloped precipitate nuclei were retained by cooling the alloys to room temperature. Contamination from the specimen chamber environment was not observed in the specimens annealed for 4 hours, but it became a serious problem above 870°C in specimens annealed for 1 week. It is argued that the contamination was due to oxygen caused by the reduction of the silica specimen tube by the Nb-Zr alloy. Thus the alloy became a ternary system and a second precipitate, which appeared to be derived from ZrO_2, became observable after annealing at the higher temperatures. (auth)

Equipment and Devices

19981 (AEC-tr-7554) PAPERS DELIVERED BY SOVIET SCIENTISTS AT THE FIRST SOVIET-AMERICAN SYMPOSIUM ON SUPERCONDUCTING CABLE TECHNOLOGY, OCTOBER 10, 1973. (Moskovskij Ehnergeticheskij Inst. (USSR)). 1974. Translated from Russian. 112p. Dep. NTIS $8.75.

The following papers are included: (1) classification of research and experimental design work on the problem of construction of superconducting power lines for transmission of direct and alternating current, (2) study of the electrical insulation of superconducting cables, (3) investigation of hydrodynamic and thermophysical processes in SC, (4) problem of limiting the short-circuit current in a superconducting ac line, (5) laboratory models of

superconducting cable, (6) current-carrying system of the experimental-industrial superconducting cable variety, (7) development of superconducting power transmission lines, (8) test stand and experimental section of superconducting cable, and (9) capacity of superconducting cable for alternating current. (MOW)

19982 (JUL-1034-TP) STUDIES ON THE THERMAL INSULATION OF LONG CRYOGENIC TRANSMISSION LINES WITH REGARD TO CRYOGENIC CABLES. Hofmann, A. (Kernforschungsanlage Juelich G. m. b. H. (F. R. Germany). Inst. fuer Technische Physik). Dec 1973. 60p. (In German). INIS.

This report briefly discusses the present state-of-art of the development of cryogenic transmission lines for power transmission systems. A review of the developments in the field of liquid natural gas transport (LNG) and liquid hydrogen transport (LH_2) is followed by a discussion of the problems encountered in the development of underground superconducting power transmission lines. (TK/CB)

19983 MAGNETIC SHIELD FOR WEAK MAGNETIC FIELD. Ogasawara, T.; Boesten, L. (Nihon Univ., Tokyo). Nippon Butsuri Gakkaishi; 28: No. 12, 1041-1049(Dec 1973). (In Japanese).

The passive magnetic shielding method for weak field is described. The shielding of the terrestrial magnetism of 0.3 Oe and the miscellaneous field of about 10^{-2} Oe are considered. The shielding with the material with high permeability is discussed. The shielding factor S = He/Hi is defined and calculated for an infinite cylindrical shell, where Hi is the intensity of internal field within the shell, and He is that of external field. The optimum design of the shielding factor S is determined by the space to be shielded and the total weight of the material to be used. The shielding factor S for alternating current field is also estimated. The results of measurement of S for the shells of various dimensions are presented and compared with theoretical values. The effects of demagnetization and shaking are presented as demagnetization factor and shaking factor. The shielding factor for longitudinal field was estimated and shown in a figure. The effect of the ends of cylindrical shells, that is leakage field, is discussed. The magnetic shielding with superconducting material is described. Some examples of the shielding with superconducting material are shown. (JA)

19984 APPARATUS FOR THE MEASUREMENT OF AC LOSSES IN SUPERCONDUCTORS. Janocko, M. A.; Deis, D. W. (Westinghouse Electric Corp., Pittsburgh). Cryogenics; 14: No. 7, 391-394(Jul 1974).

An apparatus is described which can measure continuous alternating current losses on superconductor samples, or other heat loads, by the calorimetric helium boil-off technique over a range of 10 mW to 50 W. This apparatus has a modular design and is easily constructed from commercially available components. The construction and operation of this apparatus is described in detail and typical results presented. (auth)

19985 POWER SUPPLY PROGRAMMING CIRCUIT FOR TESTING SUPERCONDUCTING WIRE. Beischer, P. (Air Reduction Co., Inc., Murray Hill, NJ). Cryogenics; 14: No. 7, 411-412(Jul 1974).

To test superconducting wire for critical current a smooth current ramp is necessary, since variations in the wire current result in erratic voltage traces, making it difficult to define the superconducting to normal transition point. A voltage programming circuit is described which produces a smooth waveform of easily adjustable duration and amplitude. With the component values given the minimum programming time is 10 s and the peak output voltage is 5 V. (UK)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 20175, 20193, 20244, and 20245.

19986 (COO-3058-46) RAPID CALCULATIONAL METHOD FOR MULTIGROUP ELASTIC TRANSFER. Becker, M. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA)). 1973. Contract AT(11-1)-3058. 13p. Dep. NTIS $4.00.

Continuous slowing-down theory is applied to the generation of elastic transfer matrices at the broad group level. When incorporated into a standard processing code, substantial savings in time were achieved while retaining acceptable accuracy. (2 tables) (auth)

19987 (FEI-326) ABSORPTION OF EPICADMIUM NEUTRONS IN BURNUP RODS CONTAINING GADOLINIUM. Karchava, G. A.; Lependin, V. I.; Morozov, I. G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1972. 7p. (In Russian). INIS.

Results are presented on the experimental determination of the fraction of epicadmium neutron absorption in cylindrical rods containing gadolinium oxide as an absorber, as a function of the concentration of gadolinium oxide and of the neutron spectrum at the position of the rod. The experimental results are compared with calculated values. (tr-auth)

19988 (HEDL-TME-73-54, pp BNL.1-BNL.5) EVALUATED CROSS SECTION LIBRARIES. Magurno, B. A. (Brookhaven National Lab., Upton, NY). Feb 1974.

In LMFBR reaction rate and dosimetry 8th progress report for period March–September 1973.

19989 (IKE-4-17) ESTOQ–A PROGRAM FOR THE CALCULATION OF FIRST COLLISION SOURCES IN ORDER TO AVOID THE RAY-EFFECT IN TWO-DIMENSIONAL S_N-CALCULATIONS. Klumpp, W.; Pfister, G.; Rexer, G. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). Aug 1974. 82p. (In German). INIS.

30 figs.; 6 refs.

The report describes the computer program ESTOQ, developed for the transformation of plane sources into first collision sources for shielding calculations. The first collision source is transmitted to the S_N program in the form of moments of a Legendre expansion. (GE)

19990 (LA-5610-MS) XSMOD: A CODE FOR THE MODIFICATION OF THE LOS ALAMOS MASTER DATA FILE. Hoyt, M. S.; McGirt, F. (Los Alamos Scientific Lab., N. Mex. (USA)). May 1974. Contract W-7405-eng-36. 118p. Dep. NTIS $5.45.

XSMOD is a CDC 6600 FORTRAN code which allows modifications to group and/or cross-section sets in the Los Alamos Master Data File. The code uses the DATATRAN data manipulation language and is modular in structure. Data sets may be added to or deleted from the library; they may be retrieved from the library and printed or may be written to a tape or disk file in a format acceptable to processing codes. A description of the code, flow diagrams, a code listing, and instructions for using the code are included. (1 table) (auth)

19991 (LA-5629-MS) LINX: LIBRARY INTERPRETATION OF NEUTRON X-SECTIONS. Soran, P. D. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1974. Contract W-7405-eng-36. 17p. Dep. NTIS $4.00.

The LINX code is used to merge single and multi-isotope libraries into a single master library. The code is written in FORTRAN and produces a binary library for both ISOTXS and BRKOXS files of the CCCC interface system. (auth)

19992 (UCID-16514, pp 3-5) COMPARISON BETWEEN THE CALCULATION USING THE ENDF/B-III, ENDF/B-IV, AND THE ENDL NEUTRON CROSS SECTIONS AND THE MEASUREMENTS FOR 0.7 M.F.P. OXYGEN. Hansen, L. F.; Komoto, T. T.; Logan, C. M.; Pohl, B. A.; Wong, C.; Anderson, J. D. Jun 1974.

In status report to USNDC.

19993 EFFECT OF A ONE-TIME TRANSMISSION OF NEUTRONS ON ARMCO AND STEEL-3. Shadmanov, R. Sh. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 2, 88-89(1974). (In Russian).

It is known that two spin states of neutrons determine the different values of the total cross section as expressed in an increase of polarization on passage of neutrons through magnetic materials. An electromagnet is one of the main units in the production of polarized neutrons. The yoke of the electromagnet was made of Armco or of Stal'-3. On Armco a value of 11.0 ± 0.5% polarized neutrons was obtained at d = 3 m, while Stal'-3 gave a value of 23.1 ± 0.6% polarized neutrons at d = 3 cm. The effect of a single transmission of neutrons on Stal'-3 can be explained by its superior magnetic properties. (SJR)

19994 SOLUTION OF THE MILNE PROBLEM USING FULL-RANGE COMPLETENESS OF CASE'S EIGENFUNCTIONS. Loyalka, S. K. (Univ. of Missouri Columbia). Nucl. Sci. Eng.; 54: No. 3, 353-356(Jul 1974).

The Milne problem for isotropic scattering for one speed and for the conservative case, (c = 1), is solved by using the full-range completeness property of Case's eigenfunctions. Explicit numerical results are derived by iterating on a very rapidly convergent Fredholm integral equation, and the results thus obtained are in excellent agreement with those obtained previously by the use of Case's half-range completeness theorem. Since for multigroup formulations the full-range completeness is more easily proved (as compared to the half-range completeness), it is felt that the present approach may prove useful. (1 table) (auth)

19995 HALF-RANGE PROBLEMS IN TWO-GROUP NEUTRON-TRANSPORT THEORY. Ishiguro, Y. Raleigh, NC; North Carolina State University (1973). 132p. University Microfilms Order No. 74-5471.

Thesis (Ph. D.).

Half-range orthogonality relations concerning the elementary solutions of the two-group neutron transport equation in plane geometry for isotropic and linearly anisotropic scattering are established. The orthogonality ralations are based on Chandrasekhar's H-type matrices and all necessary normalization integrals are evaluated so that the desired expansion coefficients may be expressed concisely in terms of inner products. The half-range orthogonality relations are used to construct tractable solutions to typical half-space problems. In addition, the required matrices are calculated to benchmark accuracy, and explicit results for several quantities of interest are reported for the Milne, albedo, and constant source problems. The established half-range orthogonality relations are used to solve critical problems for slabs and spheres with isotropic scattering and for slabs with anisotropic scattering. Exact values of critical dimensions are reported for selected sets of parameters. (Diss. Abstr. Int., B)

19996 ANISOTROPIC DIFFUSION COEFFICIENT IN A CYLINDRICAL CELL BY INTEGRAL TRANSPORT THEORY. Takeda, T.; Sekiya, T. (Osaka Univ.). J. Nucl. Sci. Technol. (Tokyo); 10: No. 11, 651-662(Nov 1973).

The anisotropic diffusion coefficient has been calculated in a cylindrical cell with use made of the integral transport theory. The previous method of calculating the diffusion coefficient requires much computer time to evaluate the generalized first-flight collision probabilities between two mesh points for a square cell. To circumvent this drawback, we introduce new calculation methods for determining the anisotropic diffusion coefficient in a cylindrical cell. Two methods are proposed—one uses the diffusion theory in the outermost moderator region of a cell, the other adopts the integral transport theory in that region as well. For the latter method, a new boundary condition is introduced for the cell surface, which, in the present problem, supersedes the usual isotropic return boundary condition. Using these two methods, the anisotropic diffusion coefficient can be evaluated with very little computer time. Moreover, an analytic expression is obtained for the special case where a cell is composed of a fuel and a moderator. (auth)

19997 SPACE AND ANGLE DEPENDENT COLLISION PROBABILITY. Ligou, J.; Stepanek, J. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen, Switzerland). Ann. Nucl. Sci. Eng.; 1: No. 3, 223-224(Mar 1974).

Brief comments are made on two different approaches to formulating the integral transport equation in terms of generalized collision probabilities in a cylindrical cell. The method described by Takeda and Sekiya is compared with an "indirect" method which attempts to simplify the integral formalism. (UK)

19998 DYNAMICS OF LIQUID H_2O AND THE THERMALIZATION OF NEUTRONS. Bansal, R. N.; Tewart, S. P.; Kothari, L. S. (Univ. of Delhi). J. Phys., D (London); 7: No. 8, 1132-1149(21 May 1974).

A study has been made of the asymptotic as well as time-dependent decay of neutron pulses in water assemblies at various temperatures in the range 0.5 to 60°C. A new scattering kernel for neutrons has been proposed which takes account of low-energy collective oscillations of H_2O molecules in the Debye approxima-

tion and which also includes contributions from rotational and intramolecular vibrational modes. The calculated values of the total neutron scattering cross section for water at 20°C are found to agree rather well with the experimental results. The values of the asymptotic decay constant calculated for different ^3B at various temperatures also agree well with the corresponding experimental results. The temperature variation of the diffusion coefficient D_0 and the diffusion cooling coefficient C is also in agreement with most of the experimental results. Transient spectra in assemblies with different ^3B and at various temperatures are successfully compared with those reported by Ishmaev et al (Pulsed Neutron Research (Vienna IAEA) 1: 643-69(1965)) and Menzel et al (Nucl. Sci. Eng.; 25: 248(1970)). The values of thermalization times t_{th} obtained by the authors are consistent with the waiting times quoted by Ishmaev et al (1965). The importance of introducing rotational and intramolecular vibrational modes, apart from the collective elastic modes, is demonstrated by neglecting the contribution of these other modes. Two cases have been considered: one corresponding to $\Theta_D = 200K$, and these other to $\Theta_D = 250K$. It is shown that under certain conditions the exclusion of rotational and intramolecular vibrational modes markedly affects various neutron thermalization parameters. (auth)

19999 NOTE ON "CALCULATION OF NEUTRON SLOWING DOWN SPECTRUM IN WATER USING GREEN'S FUNCTION" BY R. A. BHATTI. Mondal, M. A. W. (Atomic Energy Centre, Dacca). Ann. Nucl. Sci. Eng.; 1: No. 2, 155(Feb 1974).

Two comments are made on the method used by Bhatti [J. Nucl. Energy; 27: 247(1973)] for calculating group fluxes. Alternate equations are put forward which, it is suggested, may give better agreement with experimental results. (UK)

20000 MEASUREMENT AND ANALYSIS OF FAST AND INTERMEDIATE NEUTRON SPECTRA IN A SODIUM ASSEMBLY. Mallen, A. N. Troy, NY; Rensselaer Polytechnic Inst. (1973). 226p. University Microfilms Order No. 74-5146.

Thesis (Ph. D.).

Neutron spectra measurements in space, energy, and angle were performed on a bulk sodium assembly, by using the pulsed R.P.I. LINAC neutron source and time-of-flight techniques. The energy range of the measurements extended from 10 eV to 10 MeV. Comparison theoretical spectra were generated by using energy-dependent transport theory with P_3 anisotropic scattering. Comparisons with experiment are made with ENDF/B-1 and ENDF/B-3 data files for sodium, and differences among the cross section files are assessed. (Diss. Abstr. Int., B)

20001 EXPERIMENTS WITH A NEUTRON BOTTLE. Steyerl, A.; Truestedt, W. D. (Technische Univ., Munich). Z. Phys.; 267: No. 5, 379-388(May 1974).

Ultracold neutron containment in closed vessels with pyrolytic graphite and copper walls was investigated at the FRM swimming-pool reactor. In the neutron energy range where containment is due to total reflection at any angle of incidence on the wall, the measured mean containment times for various velocity intervals show a strong decrease for neutron velocities close to the upper limiting value approximately 5.8 m/s for total reflection at normal incidence. Measurements with higher velocities in the range $10 < v < 50$ m/s at temperatures from 87 to 295 K show that that the diffuse reflectivity of electro-graphite is large for neutron velocities up to approximately 30 m/s. This is explained by strong elastic scattering due to the inhomogeneous microstructure of graphite. Values up to 0.96 were obtained for the albedo at 87 K. (auth)

20002 MODERATION OF NEUTRONS IN THE PRESENCE OF INELASTIC SCATTERING. Medvedev, Yu. A.; Metelkin, E. V.; Trukhanov, G. Ya. At. Energ. (USSR); 36: No. 4, 277-281(Apr 1974). (In Russian).

The retardation of neutrons taking into account inelastic scattering in a heavy ($M \gg 1$, where M is the mass number of the moderator nucleus), infinite, homogeneous medium from a stationary, uniformly distributed source was investigated analytically. The results obtained are applicable for most materials used in reactor construction. (auth)

20003 TIME-DEPENDENT TRANSPORT VIA THE CONTINUED FRACTION APPROXIMATION. Yingling, W. A. Wright-Patterson AFB, Ohio; Air Force Inst. of Tech. (1973). 125p. University Microfilms Order No. 74-1109.

Thesis (Ph. D.).

The time-dependent neutral particle transport problem of an isotropic Green's function source in homogeneous, isotropic, spherically symmetric media is examined by using the finite set of time-dependent P–N equations and integral transform techniques. The approximate Green's function solutions in transform space for the all-angle flux corresponding to the P–N approximation of order N are determined to order P-9, and demonstrate a multiple wave nature upon inversion. An examination of the set of P–N solutions leads to the development of the complete (P-∞) continued fraction solution in transform space. For pure absorbing media the continued fraction is related to an analytic function which, upon inversion, yields the exact analytical solution to the problem. For cases with low-order scattering moments the continued fraction solution yields closed form functions in transform space, but these have not yielded to useful inversion. However, a continued fraction approximation technique is developed which yields simple, closed-form approximate solutions for the case of isotropic scatter. Simply stated, in the continued fraction technique an approximation is developed for the portion of the complete (P-∞) solution in transform space which would otherwise be discarded in the standard P–N technique. The approximate solution, when inverted, is simple in form but shows remarkable spatial and temporal resolution when compared with discrete-ordinate and other results. Useful particle conservation is shown for weakly absorbing media. The similar time-dependent plane source problem is also examined, and similar results are obtained. Finally, the steady-state problems in both spherical and plane geometry yield simple approximate solutions from the continued fraction technique which compare well with Case's exact solutions. (Diss. Abstr. Int., B)

20004 SOME THEORETICAL CONSIDERATIONS OF NEUTRON RETHERMALIZATION NEAR TEMPERATURE AND POISONING DISCONTINUITIES IN LIGHT WATER. Beynon, T. D.; Moon, J. R. (Univ. of Birmingham, Eng.). J. Phys., D (London); 7: No. 8, 1150-1158(21 May 1974).

A numerical investigation is made of neutron rethermalization effects in light water near physical temperature discontinuities and discontinuities in 1/v-poisoning. It is shown that calculations of effective neutron temperatures in unpoisoned water systems possessing only temperature discontinuities are insensitive to the details of the scattering model assumed, and that rethermalization occurs within 1 cm of the temperature interface. However, with or without the presence of physical temperature discontinuities but with one region poisoned, effective temperature differences of up to 70°K exist between predictions using the Nelkin model and the Haywood frequency distribution for the water molecule. In this case, rethermalization occurs up to 2 cm into the poisoned region. (auth)

20005 NEUTRON TRANSPORT BENCHMARK CALCULATIONS. I. PALLAS Calculations. Takeuchi, K.; Yamaji, A. (Ship Research Inst., Tokai, Japan). J. Nucl. Sci. Technol. (Tokyo); 11: No. 2, 49-57(Feb 1974).

Five benchmark problems were selected as standards for the evaluation of calculations on neutron penetration. For three of these problems there were available reliable experimental results obtained in absolute intensities of the neutron angular spectrum in graphite and in water and of the neutron reaction rate in a two-dimensional water shield. The two remaining problems were based on PALLAS transport calculations in graphite and in water in plane geometry. For the first three problems, comparisons were made between the results of PALLAS calculations using ENDF/B-I cross sections and those obtained by experiment. It is concluded that the PALLAS calculations result in fairly good agreement with experiment, except at certain spatial meshes in two-dimensional geometry, due to ray effect. Comparisons are also made of the angular flux spectrum in graphite between calculations using ENDF/B-I and B-III data, as well as of the scalar flux spectrum in water between those by PALLAS and by ANISN codes. (auth)

20006 CHARACTERISTICS OF DISCRETE Sn CALCULATION FOR ANGULAR DISTRIBUTION AND SCALAR FLUX OF NEUTRONS PENETRATING THROUGH MEDIA. Takeuchi, K.; Yamaji, A. (Ship Research Inst., Tokai, Japan). J. Nucl. Sci. Technol. (Tokyo); 11: No. 3, 81-90(Mar 1974).

The significant discrepancies often observed between the discrete Sn calculations and the measurements of the angular flux spectrum of neutrons at an angle of 0° have been studied for the benefit of analyses of time-of-flight measurements. Examination of the uncollided angular flux and scalar flux distribution yielded information on the relation between the accuracies obtainable in the calculations and the order of quadrature set used therein. Predictions on the angular flux in graphite resulting from the use of S_{16}, S_{32} and S_{48} quadratures, and on the scalar flux in water from the S_{16} quadrature were compared with the results of measurements and of PALLAS transport calculations. It was found as a result that the S_{48} quadrature is most suitable for analyzing the 0° angular flux spectrum of the time-of-flight measurements, and that the S_{16} quadrature is sufficient for scalar neutron flux calculations for reactor shields. The spurious fluctuations observed in the ANISN angular distributions are not due to insufficiency in the number of iterations in computation, but to the coarseness of the spatial intervals used. (auth)

Nuclear Properties and Reactions, $A \leq 5$

Refer also to abstract 19846.

20007 (KHFTI-73-9, pp 67-69) STUDY OF d(e,e',p)n REACTION AT ELECTRON ENERGY 1194 MeV. Antuf'ev, Yu. P.; Agranovich, V. L.; Kuz'menko, V. S.; Sorokin, P. V. (Physical-Technical Inst., Kharkov). 1973. (In Russian).

The reaction d(e,e',p)n was experimentally studied at original electron energies of 1194 MeV as a function of the proton emission at constant values of the momentum $|\vec{q}|$ and as a function of $|\vec{q}|$ during constant emission energy. As a result of the measurements at $|\vec{q}| = 0$ the cross section of $(9.2 \pm 0.9 \times 10^{-31}$ cm^2/ster^2 MeV (after correction) was obtained. This value agrees well with the theoretically calculated value equal to 9.8×10^{-31} cm^2/ster^2 MeV. The results confirmed the utility of the pulse plane-wave approximation for the description of this reaction in the region of electron energies of several GeV. (tr-auth)

20008 (SUNI-28, p 11) POLARIZATION IN NEUTRON-DEUTERON SCATTERING. Steinbock, M.; Brooks, F. D.; van Heerden, I. J. (Southern Universities Nuclear Inst., Faure, South Africa). 1973.

20009 (SUNI-28, p 12) N-D BREAKUP CROSS SECTION BETWEEN 8 AND 22 MeV. Pauletta, G.; Brooks, F. D. (Southern Universities Nuclear Inst., Faure, South Africa). 1973.

20010 CROSS SECTION AND ANGULAR DISTRIBUTIONS FOR THE REACTION ^{4}Heγ,n)^{3}He. Irish, J. D. (Toronto; Univ. of Toronto (1973). National Library of Canada, Ottawa.

Thesis (Ph. D.).

The differential photoneutron cross section for ^{4}He was measured at a laboratory angle of 98° for excitation energies between 23 and 37 MeV by using a ^{4}He gas target at a pressure of 51 atmospheres and with a liquid ^{4}He target at its normal boiling point for excitation energies between 22 and 32 MeV. Although each cross section individually agrees with previously published results, the two measured cross sections disagree with one another, the cross-section values obtained with the gas target being approximately a factor of 1.9 greater than those obtained with the liquid target. This apparent dependence of the ^{4}Heγ,n)^{3}He cross section upon the photodisintegration target used casts doubt upon the values of the ratio $\sigma\gamma$,p)/$\sigma\gamma$,n) obtained by comparing ^{4}Heγ,p)^{3}H and ^{4}Heγ,n)^{3}He cross sections measured with different target types. The angular distribution of the photoneutrons was also measured by obtaining photoneutron energy spectra at 53°, 68°, 83°, 98°, 128°, and 143°, with a liquid ^{4}He target. The angular distributions were consistent with the excitation being predominantly E1 followed by the emission of a p-wave neutron into a channel of channel spin zero. Evidence was seen for a small E2 intensity (~1% of the E1 intensity) in the excitation energy region below 27 MeV. It appears that the E2 strength increases somewhat above 27 MeV. The total cross section was inferred from the angular distribution coefficients and the 98° cross section obtained with the gas target. The values obtained for the cross section were used to obtain the values of the ratio $\sigma\gamma$,p)/$\sigma\gamma$,n) in the region of the giant dipole resonance. (Diss. Abstr. Int., B)

20011 ALPHA-NUCLEUS POTENTIAL AND THE STRUCTURE OF THE ALPHA-PARTICLE. Ceausescu, V. (Institutul de Fizica, Bucharest); Holan, S.; Sandulescu, A. Z. Naturforsch.; 29A: No. 2, 275-277 (Feb 1974).

In the first-order approximation, it is shown that the inclusion of higher shell model orbitals in the intrinsic wave function of the alpha particle gives alpha-nucleus potentials of the Woods-Saxon type with the same radius and diffusivity as for typical nucleon-nucleus potentials and with a depth equal to the sum of the four nucleon-nucleus depths. We concluded that the alpha-nucleus potentials must have the same ranges for radius and diffusivity as the nucleon-nucleus potentials. (2 figures) (auth)

20012 TRANSFER POLARIZATION OF THE D(d,n)^{3}He REACTION AND THE SCATTERING OF POLARIZED NEUTRONS FROM ^{4}He AND ^{3}He. Lisowski, P. W. Durham, NC; Duke Univ. (1973). 166p. University Microfilms Order No. 74-10,746.

Thesis (Ph. D.).

Neutron polarizations produced by inducing the D(d,n)^{3}He reaction with polarized deuterons were obtained for deuteron energies from 3.6 to 14.6 MeV in approximately 0.5-MeV steps. Determinations of the polarization were made by scattering the neutrons, produced at a reaction angle of 0°, from a high-pressure ^{4}He gas scintillator. Neutrons which scattered through 120° lab were detected by plastic side scintillators. In a separate experiment the zero-degree tensor analyzing power for the D(d,n)^{3}He reaction was obtained from the ratio of the neutron intensity for deuteron beams with transverse spin to the intensity for deuteron beams with longitudinal spin. This analyzing power measurement was made in 0.5-MeV steps for deuteron energies from 1.5 to 15.2 MeV. Zero-degree polarization transfer coefficients for the D(d,n)^{3}He reaction were then deduced from the neutron polarization and the zero-degree analyzing power values. In two other sets of measurements, precision angular distributions of the asymmetry for the scattering of 8.0-, 12.0-, and 17.1-MeV polarized neutrons from ^{3}He and 14.0- and 17.1-MeV neutrons from ^{4}He were determined. In this case the neutron-helium scattering angles were varied over the range from 40° to about 150° lab, in about 5° increments for the ^{3}He(n,n)^{3}He work and in 10° increments in the ^{4}He(n,n)^{4}He experiment. An analysis of all of the available n+ ^{3}He differential cross-section, total cross-section and polarization data was conducted in terms of phase shifts. The possibility of representing the n+ ^{3}He system by means of a standard optical model was investigated. The ^{4}He(n,n)^{4}He polarization data at 14.0 and 17.1 MeV were incorporated in a multi-energy R-matrix analysis of the p-^{4}He and n-^{4}He systems below 20 MeV. The possibility of improving the optical model parameterization of n-^{4}He and p-^{4}He, particularly at energies above 14 MeV, was investigated. The resulting parameters varied smoothly with energy. (RWR)

20013 STUDY OF DEUTERON BREAKUP REACTIONS BY PROTONS AT 65, 85, AND 100 MeV. Cheng, V. K. College Park, MD; Univ. of Maryland (1973). 131p. University Microfilms Order No. 74-9786.

Thesis (Ph. D.).

Coplanar energy sharing spectra for p + D breakup at 65, 85 and 100 MeV bombarding proton energies were measured by determining the energies of either two protons or one proton and one neutron in coincidence. The detector angles were chosen to enhance either the p-p or p-n quasi-free scattering, or the p-n final state interaction. The energy dependence of the peak cross section at equal symmetric quasi-free scattering angle pairs was extracted for the D(p,2p)n and D(p,pn)p reactions. Quasi-free angular distributions were obtained for D(p,2p)n at 65 MeV and for D(p,pn)p at 65, 85 and 100 MeV. The plane-wave impulse approximation theory can only qualitatively reproduce the shape of the quasi-free scattering peak in the energy sharing spectra and the shape of p-p quasi-free angular distribution. The discrepancies observed between the plane-wave impulse approximation theory and the experimental data imply that the presence of the spectator particle (i.e., the multiple scattering effects) has a strong influence on the magnitude and the shape of the experimental results. Multiple scattering calculations were carried out with the three-body model of Aaron, Amado, and Yam except that the S-wave separable two-body amplitudes were modified to fit two-nucleon elastic scattering data at higher energies. Comparisons of the results of these multiple scattering calculations to the experimental data show excellent quantitative agreement throughout the energy range and the angular region of this experiment, except for a few cases in which this model is inherently insufficient. (Diss. Abstr. Int., B)

20014 DETERMINATION OF DOUBLET PHASES FOR n-d SCATTERING AT LOW ENERGY. Bovet, D.; Jaccard, S.; Weber, J. (Univ., Neuchatel, Switzerland). Helv. Phys. Acta; 46: No. 5, 659-669(1973). (In French).

Phase-shift analyses in the framework of the J-degenerate model were made for n-d elastic scattering at low energy, each one using as initial values of the parameters one among the many phase-shift sets published up to now. It is shown that the "starting point" of the analysis has a definite influence on the results, which are, at least as far as the doublet phases are concerned, widely scattered. The situation is very much improved if one includes in the phase-shift analysis experimental values of the depolarization factor, D. Preliminary results of measurements of D at 2.45 MeV are given. Some difficulties encountered in analysis using the effective range approximation are pointed out. (6 figures, 2 tables) (auth)

20015 PROTON-PROTON SCATTERING IN THE ENERGY REGION FROM 500 TO 2000 keV: EXPERIMENTAL METHOD. Muehry, H.; Wassmer, H.; Baumgartner, E. (Univ., Basel). Helv. Phys. Acta; 46: No. 5, 604-625(1973). (In German).

A scattering chamber was built in order to measure precise differential proton-proton cross sections at energies between 500 and 2000 keV at three fixed angles of 12°, 25°, and 45° in the laboratory system. Effects which determine the shape and character of observed spectra and which affect the absolute value of the measured cross sections were investigated experimentally. Methods of correction and values of the observed and calculated effects are presented. (9 figures, 6 tables) (auth)

20016 PROTON-PROTON SCATTERING IN THE ENERGY REGION FROM 500 TO 2000 keV: RESULTS AND EVALUATION. Wassmer, H.; Muehry, H. (Univ., Basel). Helv. Phys. Acta; 46: No. 5, 626-634(1973). (In German).

Precise differential cross sections for proton–proton scattering were measured at the energies 1.881 MeV, 0.992 and 0.499 MeV simultaneously at angles, 24°, 50°, and 90° in the center-of-mass system. The total uncertainties vary from 0.1% at 1.881 MeV and 0.992 MeV to 0.8% at 0.499 MeV and 90°. A satisfactory agreement between a phase-shift analysis and the data can only be obtained by introducing a "strength factor," A, for the vacuum-polarization contribution. (4 figures, 8 tables) (auth)

20017 HEAVY-ION ELASTIC SCATTERING AT HIGH ENERGIES. Wang, W. L. (Carnegie-Mellon Univ., Pittsburgh); Lipes, R. G. Phys. Rev., C; 9: No. 3, 814-822(Mar 1974).

Relativistic heavy-ion scattering is investigated in terms of a coherent droplet model, where the colliding nuclei are treated as droplets of nuclear matter with no internal structure. The interaction between nuclei is assumed to be proportional to the amount of interpenetrating matter. The matter distribution is taken from electron scattering experiments, and relate the interaction parameter by the optical theorem to the total cross section. Calculations were performed at incident kinetic energies of 2.1 GeV/nucleon for ^{4}He, ^{12}C, and ^{16}O, and obtain a general diffraction pattern in the differential cross section. An interesting scaling property of heavy-ion scattering, as compared to particle-nucleus or black-sphere scattering, is shown. (auth)

20018 SEPARABLE-INTERACTION MODEL FOR PD ELASTIC SCATTERING. Wallace, J. M. (Univ. of Maryland, College Park). Phys. Rev., C; 9: No. 3, 897-901(Mar 1974).

An exactly soluble three-nucleon model for describing medium-energy Nd scattering processes is developed. The model, which is an outgrowth of the three-nucleon model of Aaron, Amado, and Yam, has been successful in describing deuteron breakup reactions through 156 MeV. It is applied to elastic scattering. Calculations of pd elastic cross sections at 31, 40, 46.3, 77, 95, and 146 MeV are carried out and compared with experiment. The model describes elastic angular distributions adequately at the lower energies considered. However, at the higher energies the model is somewhat less successful over at least part of the angular range than it is for lower-energy elastic scattering or for breakup throughout this energy range. We attribute this to the rather crude character of the pn input at higher energies, which manifests itself more clearly in the elastic cross sections. (auth)

20019 SEPARABLE POTENTIALS FOR THE NUCLEON–NUCLEON $^3S_1-{}^3D_1$ CHANNEL. Pieper, S. C. (Argonne National Lab., IL). Phys. Rev., C; 9: No. 3, 883-896(Mar 1974).

Separable potentials of rank one to five for the nucleon–nucleon $^3S_1-{}^3D_1$ channel are constructed using a method introduced by Ernst, Shakin, and Thaler. The potentials all have the same deuteron wave function as the Reid soft-core potential. In addition the phase shifts of the rank-four and -five potentials are quite close to the experimental phase shifts. A survey of previously published separable potentials of rank greater than one is made and it is concluded that most of these potentials have unacceptably poor deuteron properties. A number of errors that were made in the fitting of these potentials to the data are pointed out. A simplification of the Reid soft-core potential for the $^3S_1-{}^3D_1$ channel is also presented. The simplified potential consists entirely of Yukawa terms but has experimental properties that generally differ from the original Reid soft-core properties by less than the present experimental error. (auth)

20020 NEUTRON–PROTON POLARIZATION MEASUREMENTS NEAR 20-MeV INCIDENT NEUTRON ENERGY. Morris, C. L.; O'Malley, T. K.; May, J. W. Jr.; Thornton, S. T. (Univ. of Virginia, Charlottesville). Phys. Rev., C; 9: No. 3, 924-928 (Mar 1974).

Using the ^{3}H(d,$\vec{n}$)^{4}He reaction as a source of polarized neutrons, measurements of the n-p polarizations have been made at 16.9 and 21.1 MeV. Results are reported at 40, 60, 80, and 140° c.m. for both energies as well as at 100 and 120° c.m. for 21.1 MeV. Comparisons are made with predictions of the LRL-X and the YALE-IV phase-shift analysis. The data favor the LRL-X analysis at forward angles and the YALE-IV analysis at backward angles. (auth)

20021 PARITY-VIOLATING ASYMMETRY IN NUCLEON–NUCLEON SCATTERING. Brown, V. R. (Lawrence Livermore Lab., CA); Henley, E. M.; Krejs, F. R. Phys. Rev., C; 9: No. 3, 935-942(Mar 1974).

The weak parity-violating component of the nucleon–nucleon interaction can be studied directly and in detail through the scattering of longitudinally polarized nucleons on nucleons. We use distorted-wave theory to predict the dependence of the differential and total cross sections on the helicity of incident longitudinally polarized protons for elastic proton–nucleon scattering at energies up to ~300 MeV. The weak force used is parametrized by ρ, ω, π, and 2π exchanges, the strong one by a Hamada–Johnston or Bryan–Gersten potential. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 19992, 20017, 20062, 20065, 20068, 20120, 20209, 20217, 20225, and 20232.

20022 (RCN-203, pp 333-357) NUCLEAR MAGNETIC RESONANCE OF SHORT-LIVED β-ACTIVE NUCLEI FORMED BY CAPTURE OF POLARIZED NEUTRONS. Gulko, A. D.; Trostin, S. S.; Bulgakov, M. I.; Oratovskii, Yu. A. (Inst. of Theoretical and Experimental Physics, Moscow). Dec 1973. (In Russian).

From nuclear physics with thermal and resonance energy neutrons; Petten, Netherlands (22 May 1973).

The method for measuring the function representing the profile of the nuclear magnetic resonance line of polarized short-lived β-active nuclei (distribution of internal crystal fields) formed by the capture of polarized thermal neutrons in the investigated sample is described. The line profile is measured by destroying, with an rf magnetic field, the angular anisotropy of β rays emitted by the polarized nuclei. An interesting feature of the NMR method described is the fact that the profile of the NMR line can be determined at frequencies very far from the resonance point. Measurements and theoretical calculations for β-active ^{8}Li nuclei ($T_{\frac{1}{2}}$ = 0.85 s) in LiF samples are made. A comparison between the theoretical calculation and the experimental results demonstrates that the internal local fields at the ^{8}Li nuclei have a Gaussian distribution and only the wings are subject to a Lorentzian deviation. (5 figures, 1 table) (auth)

20023 REACTIONS ^{10}B(α, n_0)^{13}N AND ^{10}B(α, p_x)^{13}C FOR $2 < E_\alpha < 8$ MeV. Wilson, S. J. Madison, WI; University of Wisconsin (1973). 105p. University Microfilms Order No. 73-32, 152.

Thesis (Ph. D.).

Data obtained simultaneously for the mirror reactions ^{10}B(α, n_0)^{13}N and ^{10}B(α, p_0)^{13}C in 50-keV steps at $\theta_{c.m.}$ = 50° and 144° for $2.1 \leq E \leq 7.0$ MeV are presented. The ratio of the cross sections of these reactions yields information about isospin mixing according to the formula $\sigma_n/\sigma_p = P_n/P_p|\beta_1-\beta_0/\beta_1+\beta_0|^2$, where β_T is the amplitude of a state of pure isospin T in the compound-nucleus state, $\sigma_{n(p)}$ is the differential neutron (proton) cross section, and $P_{n(p)}$ is the neutron (proton) penetrability. Data for ^{10}B(α, p_x)^{13}C in 50 keV steps at eleven angles for $2.05 \leq E \leq 7.95$ MeV are also presented. The four proton groups studied leave ^{13}C in either its $\frac{1}{2}^-$ ground state or its $\frac{1}{2}^+$ 3.086, $\frac{3}{2}^-$ 3.684, or $\frac{5}{2}^+$ 3.854 MeV excited states. In the case of p_0, the incident energy range extends to 10.75 MeV the $E_\alpha < 8$ MeV cross sections were expanded in Legendre polynomials, and the coefficients at some resonances were fitted with a nonlinear regression analysis program. Evidence for apparent isospin mixing and also level parameters and spin–parity possibilities for several levels in ^{14}N*, some of which have not been described previously, are presented. (Diss. Abstr. Int. B)

20024 EXPERIMENTAL AND THEORETICAL STUDY OF THE ^{9}Be(^{6}Li, ^{7}Li)^{8}Be REACTION AND THE ELASTIC SCATTERING OF ^{6}Li FROM ^{9}Be. Von Behren, P. L. Iowa City, IA; University of Iowa (1973). 80p. University Microfilms Order No. 74-7445.

Thesis (Ph. D.).

Absolute angular distributions for the ^{9}Be(^{6}Li, ^{7}Li)^{8}Be reaction were measured for 5.5 and 6.5 MeV incident beam energies. Elastic-scattering data for ^{6}Li on ^{9}Be were taken to ascertain optical-model parameters. Fits to the transfer-reaction data using a finite-range DWBA computer code indicate that the transfer process is primarily direct. (Diss. Abstr. Int., B)

20025 STUDY OF THE (^{3}He, ^{7}Be) REACTION: A COUPLED-CHANNELS FINITE-RANGE ANALYSIS. Pisano, D. J. Jr. New Haven, CT; Yale Univ. (1973). 193p. University Microfilms Order No. 74-11,863.

Thesis (Ph. D.).

A study was made of the (^{3}He, ^{7}Be) reaction in order to determine the reaction mechanism and to investigate alpha-particle clustering in light nuclei of importance in the silicon burning process. Angular distributions were measured for ^{12}C, ^{16}O, and ^{24}Mg targets with ^{3}He bombarding energies in the range 25.5 MeV to 29.0 MeV. Data were extracted for transitions to low-lying states in the residual nuclei. The differential cross section at forward angles declined from 500 μb/sr for the ^{12}C target to 50 μb/sr for the ^{24}Mg target. Angular distributions were forward-peaked, and those for ground-state transitions showed oscillatory

structure. Angular distributions for $^{7}Be_{(0)}$ and $^{7}Be_{(1)}$ were similar and in the ratio of approximately 2:1 for most cases; a notable exception was for the transition of the $^{20}Ne(1.63)$ state, where the $^{7}Be_{(0)}$ angular distribution was considerably flatter and stronger than that of $^{7}Be_{(1)}$. A computer program was written to analyze this alpha-pickup reaction in an exact finite-range, coupled-channels Born approximation. Including recoil exactly, the transfer was treated within the framework of the cluster model. In the case of the $^{24}Mg(^{3}He, ^{7}Be)^{20}Ne$ reaction the data could be satisfactorily fit only when coupling between the 0^{+} and 2^{+} states in both the entrance and exit channels was explicitly included. The $^{12}C(^{3}He, ^{7}Be)^{8}Be$ data could be adequately fit with a finite-range DWBA calculation at center-of-mass angles to 70°. Beyond 70° there are indications of a reaction mechanism different from direct alpha transfer, such as heavy-ion transfer or compound-nucleus formation. Apart from an arbitrary normalization, a fixed-range DWBA calculation of the angular distribution for the $^{8}Be(0.0)$ state. From these analyses a set of parentage coefficients was extracted which measure the four-nucleon clustering in the ground states of these nuclei. (Diss. Abstr. Int., B)

20026 SURVEY OF (^{12}C, α) REACTIONS OF SEVERAL TARGETS AND INVESTIGATION INTO POSSIBLE DIRECT REACTIONS IN $^{11}B(^{12}C, \alpha)^{19}F$. Hartwig, W. Manhatten, KS; Kansas State University (1973). 60p. University Microfilms Order No. 74-6652.

Thesis (Ph. D.).

To study the (^{12}C, α) reaction, alpha-particle spectra were measured at 0° and 30° with silicon surface barrier detectors for the target nuclei of ^{11}B, ^{12}C, ^{18}O, and ^{40}Ca, and with a ^{13}C beam on ^{12}C. The laboratory energy of the incident beam ranged from 15.5 to 27.0 MeV and was varied in half-MeV steps. For the reactions leading to ^{19}F, ^{20}Ne, and ^{21}Ne, large fluctuations were observed in the cross section vs. beam energy curves; these were strongest in ^{20}Ne and weakest in ^{19}F. Peaks in the excitation function for the lowest three states of ^{20}Ne agreed well with previously published data, where they are explained completely as compound-nucleus reactions. The ^{19}F excitation functions showed a maximum at 18.5 MeV laboratory beam energy for the 3.91 to 4.04 MeV group of states and a maximum at 22.5 MeV for the 1.35 to 1.55 MeV group. To determine whether direct reactions played any role in the population of those states at the particular resonance energies $\alpha-\gamma$ coincidence measurements were undertaken at 18.5, 22.5, and 26.0 MeV, and an angular distribution was obtained at 18.5 MeV for 15 laboratory angles between 8° and 165°. Even with a high resolution Ge(Li) detector it could not be distinguished whether the 1.46-MeV, $\frac{5}{2}^{-}$ or the 1.55-MeV, $\frac{5}{2}^{+}$ state was being populated, because of the low coincidence counting rate. A direct reaction process would, however, rule out the 1.55 MeV $\frac{5}{2}^{+}$ state. In order to support the measured evidence for a direct reaction contribution, a semiclassical calculation, involving a grazing collision, was done, and the results were checked for the known case of ^{20}Ne. The sum of evidence points strongly to the presence of a direct reaction mechanism in the population of certain states in ^{19}F for the $^{11}B(^{12}C, \alpha)^{19}F$ reaction. (RWR)

20027 STRUKTURA YADER 1p-OBOLOCHKI. (Structure of 1p-SHELL NUCLEI). Boyarkina, A. N. Moscow; Izdatel'stvo Moskovskogo Universiteta (1973). 62p.

A study of 1p-shell nuclei is of particular interest in understanding nuclear structure. The most successful theoretical interpretation of nuclear properties is connected with the use of a shell model with intermediate coupling. The first chapter deals with calculating wave functions in the shell model with intermediate coupling. The second chapter tabulates wave functions of 1p-shell nuclei. Energy levels of these nuclei are listed in chapter 3. Fractional parentage coefficients and spectroscopic factors of nucleons are tabulated in chapter 4. Multiparticle fractional parentage coefficients and spectroscopic factors of deuterons, tritons (^{3}He nuclei), and alpha particles are tabulated in chapter 5. These data can be used in analyzing direct nuclear reactions such as quasi-elastic knock-on reactions, pickup reactions, etc. The book is intended for researchers in the field of light nuclei. (106 tables) (SJR)

20028 ANGULAR DISTRIBUTION OF THE REACTION $^{7}Li(d,\alpha)^{5}He$ FOR INCIDENT ENERGIES VARYING FROM 600 TO 1250 KeV. Robaye, G.; Delbrouck-Habaru, J. M.; Garnir, H. P.; Huez, M. (Univ., Liege). Bull. Soc. Roy. Sci. Liege; 42: No. 11-12, 598-607(1973). (In French).

Sixteen angular distributions of the $^{7}Li(d,\alpha_1)^{5}He$ reaction have been measured between 0.6 and 1.25 MeV in steps of about 40 keV. The angular distributions have been fitted in the center of mass system in terms of Legendre polynomials. The analysis seems to give a positive parity state ($\frac{3}{2}^{+}$ or $\frac{5}{2}^{+}$) for the 17.28 MeV level of ^{9}Be while a negative ($\frac{3}{2}^{-}$, $\frac{1}{2}^{-}$ or $\frac{1}{2}^{-}$) state is indicated for the 17.48 MeV level. This is not the order of parities as usually given in the literature. (auth)

20029 ELASTIC SCATTERING STUDIES IN ^{18}F. Herman, A. W. Kingston, Ont.; Queen's Univ. (1972). 131p.

Thesis.

States of excitation between 6 and 7 MeV in ^{18}F have been studied utilizing the $^{14}N(\alpha,\alpha)^{14}N$ reaction. A curve fitting shape analysis of the elastic scattering cross section utilizing the χ^2 test extracted the total and partial level widths, Γ and Γ_α, respectively. Resonances at $E\alpha$ = 2160, 2350, 2370, 2767, 2866 and 2871 keV were studied populating states in ^{18}F at Ex = 6095, 6244, 6259, 6567, 6642 and 6645 keV respectively. The respective alpha and total widths obtained for these states are (Γ_α,Γ) = (0.13, 0.45), (0.20, 0.55), (0.75, 2.0), (0.44, 0.46), (67, 77) and (0.39, 1.3) keV (c. of m.). Preliminary experiments on the $^{14}N(\alpha,\gamma)^{18}F$ reaction at $E\alpha$ = 2871 keV and Ex = 6645 keV resulted in the study of the decay and angular distributions of four γ-rays at 5708, 4544, 3511 and 1138 keV decaying from the 6645 keV state. The resonance yield for this state was measured as $\omega\gamma$ = 1.4 ± 0.2 eV. From the elastic scattering, angular distribution work and γ-ray width of this state, the assignment of J^{π}, 1, T = 2^{-}, 1, 1 was made. The 6645-keV state was assigned as the analogue of the 5.52-MeV 2^{-} state in ^{18}O. The analogue–anti-analogue character of states at 6645 and 2101 keV, $J^{\pi} = 2^{-}$ is also proposed. (auth)

20030 NEUTRON–PROTON COINCIDENCES FROM THE $^{12}C(^{16}O,np)^{26}Al$ REACTION. Valkovic, V.; Liebert, R. B.; Plasek, R.; Wheeler, R. M.; Zabel, T.; Phillips, G. C. (Rice Univ., Houston, TX). Lett. Nuovo Cim.; 10: No. 11, 461-465(13 Jul 1974).

Studies of oxygen-16-induced reactions at an energy of 30 and 36 MeV which have at least three particles in the final state, one of them being a neutron, are reported. Cross sections, distributions, and missing mass spectra are reported. (JFP)

20031 ELASTIC SCATTERING OF α-PARTICLES ON ^{9}Be. Saleh, Z. A.; Machali, F.; Bondouk, I. I.; Darwish, D. A. (Atomic Energy Establishment, Cairo). Ann. Phys. (Leipzig); 31: No. 1, 76-82(1974).

The differential cross section for the elastic scattering of He^{4} particles on Be^{9} was studied in the bombarding energy range 1.4 to 2.5 MeV. The excitation functions for the elastically scattered α-particles from Be^{9} were measured at six angles 90, 125, 132, 140, 150, and 160° in the center of mass system. A clear and pronounced resonance is observed in the measured cross section at incident α-particle energy 1.93 MeV. Analysis of the data in terms of the single level approximation theory leads to the assignment $J^{\pi} = 5^{+}/2$ for the observed resonance. Reduced and partial widths for elastic scattering were determined. (auth)

20032 NON-ELASTIC CROSS SECTION OF ^{9}Be FOR NEUTRONS BETWEEN 2.4 AND 3.9 MeV. Weaver, D. R.; Walker, J. (Univ. of Birmingham, Eng.). J. Phys., D (London); 7: No. 8, 1122-1131(21 May 1974).

Shell transmission measurements were made in beryllium with neutrons between 2.4 and 3.9 MeV and analyzed by a new method based on the line integral transport equation. The non-elastic cross section for ^{9}Be was derived. (auth)

20033 STUDY OF THE REACTION $^{11}B(^{3}He,\gamma_{0,1})^{14}N$ FROM $E_{^{3}He}$ = 1.5 MeV TO 6.1 MeV. Maute, R. E. Columbus, OH; Ohio State Univ. (1973). 106p. University Microfilms Order No. 74-11,013.

Thesis (Ph. D.).

A study of the reaction $^{11}B(^{3}He,\gamma_{0,1})^{14}N$ was undertaken to investigate the giant dipole resonance (GDR) region of ^{14}N for comparison with other theoretical and experimental treatments of the GDR of ^{14}N. The differential cross sections for the reaction $^{11}B(^{3}He, \gamma_{0,1})^{14}N$ were measured from 1.5 MeV to 6.1 MeV for transitions to the ground and first excited state. Two peaks were observed in the γ_0 excitation curve at bombarding energies of approximately 3.6 MeV and 5.2 MeV (including penetration effects). A single resonance was observed in the γ_1 excitation curve at a bombarding energy of 4.0 MeV. Upon comparison of the reaction under study with the dominant (γ,p) and (γ,n) GDR reactions, little correspondence was seen—this result indicated that different states were being excited. Angular distributions for transitions to the ground state were taken for each resonance, and at two off-resonance positions. Analysis of the angular distributions led to a tentative spin and parity assignment of 1^{+} for the 3.6-MeV resonance, and 2^{-} for the 5.2-MeV resonance. (Diss. Abstr. Int., B)

20034 TWO-NUCLEON PICKUP REACTIONS FROM OXYGEN-18. Ohanian, R. S. Princeton, NJ; Princeton Univ. (1973). University Microfilms.

Thesis (Ph. D.).

The $^{18}O(p,t)^{16}O$ and $^{18}O(p,^{3}He)^{16}N$ reactions were observed at laboratory scattering angles from 15° to 85° with an incident pro-

ton beam of 41.8 MeV. Angular distributions for 58 states in ^{16}O up to excitation energy of 24.5 MeV were extracted, as well as 37 states of ^{16}N up to an excitation energy of 9.93 MeV. Supplemental studies of the $^{16}O(p,t)$, $^{16}O(p,^3He)$, and H(p,p') reactions at E_p = 41.8 MeV, the $^{18}O(p,t)$ reaction at E_p = 27.9 MeV, and the $^{16}O(d,d')$, $^{18}O(d,\alpha)$, and $^{16}O(d,\alpha)$ reactions at E_d = 28.0 MeV were also performed. A search was made for a $J\pi;T = 0+;1$ 2-particle–2-hole state in ^{16}O. A strong 0+ state was found at 16.33 MeV, but it appears to be T = 0. States of unnatural parity, "forbidden" in the $^{18}O(p,t)$ reaction, were observed. States of 0–, 1+, 2– and possibly 3+ were of surprisingly large yield. This suggests a breakdown of the usual one-step direct reaction model, possibly involving a D-admixture in the triton or a multi-step mechanism. The first evidence for population of the giant dipole resonance of ^{16}O in particle transfer reactions was obtained. For states to which a correspondence could be made, the relative strengths and angular distributions of the experimental results were compared with a DWBA analysis. With each interaction a small change in the exit channel parameters is also presented for comparison. In light of the approximations implicit in the theory, there is substantial agreement among the four theoretical cases. For the 0+ states of ^{16}O the agreement between theory and experiment is excellent. For other states of ^{16}O and ^{16}N, agreement is generally fair, with some excellent but other divergent comparisons. Possibly much of the latter is explained by the fact that the model has the $1s_{1/2}$, $1p_{3/2}$ and $1d_{3/2}$ shells inactive. The observation of unnatural-parity states in the $^{18}O(p,t)$ reaction means the usual DWBA model should not be taken too literally here in any event. (RWR)

20035 INDUCED WEAK CURRENTS AS DETERMINED BY BETA–ALPHA ANGULAR CORRELATIONS IN MASS 8. Tribble, R. E. Princeton, NJ; Princeton Univ. (1973). University Microfilms.

Thesis (Ph. D.).

Electron–alpha and positron–alpha angular correlations were measured in the ^8Li–^8Be–^8B triplet. The experimental angular correlations were fitted to a distribution of the form $W(\theta_{e-\alpha}) = 1 + a\cos\theta_{e-\alpha} + pc\cos^2\theta_{e-\alpha}$. The coefficient p, which contains induced weak currents that interfere with the allowed Gamow–Teller transition, along with second-forbidden contributions, was analyzed by using the impulse approximation. Comparing the electron–alpha and positron–alpha correlations allows the weak magnetism and vector second-forbidden matrix elements to be separated from the axial vector second-forbidden matrix elements and a predicted first-class induced tensor contribution. The experimental results indicate that the contributions from the vector second-forbidden matrix elements were small compared to weak magnetism. Assuming no second-forbidden contributions gave the result $p_- - p_+ = (.0072 \pm .0004)E$, where p_- and p_+ are the $\cos^2\theta$ coefficients for ^8Li and ^8B respectively. With the further assumption of no second-class axial-vector currents, the experimental result would correspond to $(W.M.)/A(G.T.) = 7.2 \pm 0.4$ for the ratio of weak magnetism to Gamow–Teller matrix elements (multiplied by the mass number A). The results for the first-class induced tensor interaction were somewhat uncertain. Wave function predictions for the axial vector second-forbidden matrix elements indicated that they are not negligible in the determination of the induced tensor interaction. The theoretical prediction, including both induced tensor and second-forbidden contributions, was found to overestimate the experimental result. The results for the kinematic coefficient a/E were found to show an energy dependance that was due to the variable value of the center-of-mass alpha particle velocity. (Diss. Abstr. Int., B)

20036 BOUND STATE EFFECTS IN (p,2p) REACTIONS. Old, J. G. Moscow, ID; Univ. of Idaho (1973). 157p. University Microfilms Order No. 74-11,773.

Thesis (Ph. D.).

The bound state effects in the (p,2p) reaction are investigated by calculating the differential scattering cross sections for the $^{14}N(p,2p)^{13}C$ at 46 MeV and the $^{19}F(p,2p)^{18}O$ at 43 MeV reactions using symmetric coplanar geometry. The formalism used to calculate the angular distributions is the distorted wave t-matrix approximation (DWTA) in the static limit. The distorted waves are assumed to be optical-model waves approximated by simple analytic forms. The t-matrix parameters are adjusted to fit p–p scattering. The bound-state wave function is described by the extreme single-particle shell model using a spherically symmetric Woods–Saxon potential and a strong spin–orbit coupling. The angular distribution is also calculated for a nonspherical Woods–Saxon potential. A reasonable fit to the experimental data is made for both reactions. The tail is found to be the most important region of the bound-state wave function; and the root-mean-square (rms) radius, the single most important bound-state parameter. The differences in the spherical and nonspherical angular distribution calculations are small for the ^{14}N reaction because it is a second-order effect. Only the magnitude of the angular distribution is affected, not the shape. The nonspherical calculation for ^{19}F is a first-order effect, and both the magnitude and shape of the angular distribution are affected. It is found in the case of ^{19}F that more experimental data are needed in the region from 50° to 60° in order to tell if the nonspherical calculation is justifiable. (Diss. Abstr. Int., B)

20037 EXCITATION FUNCTIONS OF THE NUCLEAR REACTIONS $^{14}N(p,\alpha)^{11}C$ AND $^{14}N(p,pn)^{13}N$. Muminov, V. A.; Mukhamedov, S.; Sultanov, B.; Khamrakulov, T. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 1, 56-58(1974). (In Russian).

In this study experimental measurements were made on the excitation functions of nuclear reactions excited by fast protons in nitrogen from the threshold to 18 MeV by means of foil piles. A number of maxima were observed on the excitation curve of the nuclear reaction $^{14}N(p, alpha)^{11}C$. The allowable measurement error did not exceed 10%. (SJR)

20038 PROBLEM OF SATURATION IN A CLUSTER MODEL. Jibuti, R. I.; Sallam, H. M. (Tbilisi State Univ., USSR). Soobsch. Akad. Nauk Gruz. SSR; 74: No. 3, 581-584(Jun 1974). (In Russian).

The saturation problem in a cluster model is considered by applying a velocity-dependent effective nucleon-nucleon potential. The ground and some excited states of ^8Be, ^{12}C and ^{16}O nuclei were considered, and it is shown that the given potential provides good values for the binding energy as well as for the clustering degree. (auth)

20039 STUDIES OF POSITIVE PARITY STATES OF NUCLEI WITH A = 6 IN THE UNITARY SCHEME MODEL. Doma, S. B. (Tbilisi State Univ., USSR). Soobshch. Akad. Nauk Gruz. SSR; 74: No. 3, 585-588(Jun 1974). (In Russian).

On the basis of the unitary scheme model calculation of the energy spectra and some characteristics of A = 6 nuclei was carried out, taking partial account of the high configurations. Two nonsingular realistic potentials are used in the calculation, one of which is defined from the two-body problem with low energy, and the other with a wider energy interval. It is shown that a more reasonable agreement with experiment is obtained from the second potential. (auth)

20040 INVESTIGATION OF THE $^{14}N(d,\alpha)^{12}C$ REACTION AT E_d = 640 TO 310 KEV DEUTERON ENERGIES. Bakr, M. H. S. (Atomic Energy Establishment, Cairo); Hunyadi, I.; Schlenk, B.; Somogyi, G.; Valek, A. ATOMKI (At. Kut. Intez.) Kozlem.; 16: No. 2, 123-132(1974).

Angular distributions of the α_0, α_1, α_2, and α_3 groups from the $^{14}N(d,\alpha)^{12}C$ reaction were measured at deuteron energies of 640, 510, and 350 keV by using solid-state track detectors. A semiconductor detector was used to measure the excitation functions of the α_0 and α_1 groups from the same reaction in the energy range 640–310 keV at $\theta_{lab} = 90°$. The absolute cross-section values are given for the alpha groups investigated. The experimentally obtained angular distributions were analyzed in terms of Legendre polynomials. The measured relative intensity ratios of the α_0, α_1, and α_3 groups could be reproduced by a simple calculation assuming statistical compound reaction mechanism. (3 figures, 2 tables) (auth)

20041 STUDIES ON THE MASS 6 SYSTEMS WITH $^3He + ^3H$ AND $^3He + ^3He$ REACTIONS. Ventura, E. Stanford, CA; Stanford University (1973). 98p. University Microfilms Order No. 74-6565.

Thesis (Ph. D.).

The main purpose is the study of the structure of ^6Li and ^6Be by means of radiative capture reactions. The $^3H(^3He,\gamma)^6Li$ capture reaction was investigated for ^3He bombarding energies from 6 to 26 MeV. Transitions to the ground and first four excited states in ^6Li were observed. 90° differential cross sections were measured for all these transitions. A direct capture model is used to interpret the observed results. ^3He–^3H resonating-group wave functions, which describe the elastic scattering problem, were employed in the calculation. The energy and angular dependence of the calculated ground state differential cross section is in very good agreement with experiment. In the case of the first excited state differential cross section, good agreement is observed at lower energies, while a marked deviation from experiment is observed at higher energies. This deviation is indicative of a resonance in the compound nucleus at $E_x = 25 \pm 1$ MeV, with configuration other than $^3He + ^3H$. Coefficients of fractional parentage were obtained for these two transitions indicating substantial ^3He–^3H clustering in these low lying states. Excitation functions for the transitions to the second, third and fourth excited states were also measured. Only the latter shows a broad maximum indicating a possible resonance in ^6Li at $E_x = 26.7 \pm 0.4$ MeV. This study was complemented by mea-

suring the $^{3}H(^{3}He,n)^{5}Li$ excitation function from 13 to 26 MeV bombarding energy. The magnitude and shape of the 20° cross section indicates that the neutron channel plays a significant role in the reaction mechanism. Also, the problem of low lying negative parity states in ^{6}Li was re-examined by investigating the $^{6}Li(^{3}He,^{3}He')^{6}Li^{*}$ reaction. No evidence for such states is obtained. The $^{3}He(^{3}He,\gamma)^{6}Be$ capture reaction was investigated for ^{3}He bombarding energies from 12 to 27 MeV. Most of the transition strength observed is to the first excited state in ^{6}Be. Capture to the ground state could not be detected. The magnitude of the 90° differential cross section and the measured angular distributions suggest the presence of electric dipole radiation. Since E1 radiation is not allowed by means of a direct capture mechanism, the observed structure is interpreted as an intermediate resonance in ^{6}Be at 23.0 ± 0.5 MeV excitation energy, with a configuration of the form α + p + p. The configurations and decay modes of some of the resonances observbed in ^{6}Li and ^{6}Be suggest that they are analogs of each other. (Diss. Abstr. Int., B)

20042 (π^{+},π^{0}) REACTION IN ^{12}C. Bonazzola, G. C. (Univ., Turin); Bressani, T.; Chiavassa, E. Lett. Nuovo Cim.; 10: No. 14, 603-609(3 Aug 1974).

Positive pion reactions with carbon-12 at 400 MeV/c were studied to determine the differential cross sections. The branching ratios to the various carbon-11 levels were evaluated. (JFP)

20043 COEXISTENCE THEORY OF ODD PARITY, T = 1 STATES IN ^{16}O. Graves, R. D. Corvallis, OR; Univ. of Oregon (1973). 62p. University Microfilms Order No. 74-12,949.

Thesis (Ph. D.).

One of the major problems of the particle-hole model of excitations in ^{16}O is that the observed structure is more complex than can be predicted by the model. To remedy this situation, additional degrees of freedom were introduced into the problem through the phenomenon of shape coexistence. It has been shown that this "coexistence model", for example, gives four states in the giant dipole region which acquire significant dipole strength as opposed to the two strong states predicted by the particle-hole model. This result is a substantial improvement in the agreement of the predicted structure of the giant dipole region with experiment. Calculations were also carried out for inelastic electron scattering on ^{16}O at low momentum transfer, q ≤ 100 MeV/c. Transition rates were studied as a function of momentum transfer; and the results, compared with experimental data. New 2^{-} structure was predicted at 19 and 23 MeV. Direct experimental tests of the model are suggested. (Diss. Abstr. Int., B)

20044 INTRINSIC MIXED-PARITY CLUSTERING IN LIGHT NUCLEI. Blethen, J. W. Palo Alto, CA; Stanford Univ. (1974). 154p. University Microfilms Order No. 74-13,603.

Thesis (Ph. D.).

A general cluster model, similar to the Brink alpha-particle model but not restricted to alpha clusters alone, is developed. States of definite angular momentum are projected from deformed intrinsic states having cluster-model symmetries of (in general) mixed parity. The model is applied to the nuclei ^{6}Li, ^{7}Li, and ^{8}Be in the two-cluster single-configuration approximation using pure LS-coupled eigenfunctions and a nucleon-nucleon force obtained from the Brink-Boeker force B1 by addition of spin- and isospin-exchange terms and of a neutral two-nucleon spin-orbit interaction term. Good agreement with the experimental magnetic dipole and electric quadrupole moments and rms charge radii is obtained; however, the calculated binding energies are significantly less than the experimental values, in agreement with the results of projected-Hartree-Fock (PHF) calculations. The excited-state spectra agree qualitatively with experiment; however, quantitative agreement is only moderately good. The limitations of the single-configuration approximation are thus indicated. The mixed-parity cluster-model intrinsic states of ^{6}Li and ^{7}Li give rise to projected rotational states of both even and odd parity. It is shown that the effective intercluster potential exhibits a strong Majorana exchange component. Only the lower rotational states are bound; higher states lead to centrifugal breakup into two free clusters. Excitation of ^{6}Li into higher (L > 2) rotational states can lead to break-up of the deuteron cluster itself. The cluster-model results are compared to parity-restricted PHF results. Advantages of the cluster-model treatment over the parity-restricted PHF treatment are discussed. (RWR)

20045 RADIATIVE CORRECTIONS TO ASYMMETRY AND ENERGY SPECTRUM OF BETA RAYS FROM POLARIZED NUCLEI. Yokoo, Y.; Suzuki, S.; Morita, M. (Osaka Univ., Toyonaka, Japan). Progr. Theor. Phys. (Kyoto); 50: No. 6, 1894-1907(Dec 1973).

The radiative corrections to the angular distribution and energy spectrum of β rays from polarized nuclei were studied. Explicit formulas of the radiative corrections are given for the angle-dependent and angle-independent terms and for the asymmetry factor, under the assumption of the effective current-current interaction of the V-ρA type for the β decay. The lowest order corrections to the first two are almost the same and depend on the cutoff. The asymmetry factor of the β-ray angular distribution is scarcely affected by the radiative corrections. In particular, these corrections are independent of the cutoff for the Gamow-Teller transition. It is also shown that the radiative corrections to the β-ray spectrum are consistent with those given by Kinoshita and Sirlin, and Berman and Sirlin. Numerical values of the radiative corrections are tabulated for the β decays, $^{12}B \rightarrow {}^{12}C + e^{-} + \bar{\nu}$ and $^{12}N \rightarrow {}^{12}C + e^{+} + \nu$. (auth)

20046 THEORETICAL STUDY OF THE DIRECT RADIATIVE CAPTURE REACTION $^{16}O(p,\gamma)^{17}F$. Chow, H. C. Vancouver, Canada; Univ. of British Columbia (1973). National Library of Canada, Ottawa.

Thesis (Ph. D.).

The radiative capture reaction $^{16}O(p,\gamma)^{17}F$ was studied theoretically by using a two-body model to estimate the capture cross sections. The $^{16}O(p,\gamma)^{17}F$ reaction is a direct capture process at low energies, which is of astrophysical interest because of its role in the C-N-O bi-cycle responsible for hydrogen burning in the larger main sequence stars. The analysis involves a detailed fitting of the $^{16}O(p,p)^{16}O$ scattering data to search for the parameters of a Saxon-Woods potential with an energy-dependent central well depth, which best describes the ^{16}O + p interaction. The best set of parameters obtained is used to generate the initial continuum and bound-state wave functions. The matrix elements of the electromagnetic interaction Hamiltonian are calculated, and first-order time-dependent perturbation theory is used to obtain the capture cross sections. The results are compared with recent experimental data, from 0.78 to 2.3 MeV, which have a significantly higher accuracy than that of previously available data. The angular distributions predicted by the theory agree satisfactorily with observed experimental data. The astrophysical S factor extrapolated to thermal energies has the value 8.53 keV-barn at 10 keV, with an uncertainty of at least 5%. Some of the methods used in the $^{16}O(p,\gamma)^{17}F$ calculations were applied to a somewhat different capture reaction, $^{6}Li(p,\gamma)^{7}Be$, which involves interferences with resonance capture. This treatment is included in an appendix; because of the limited experimental data on this reaction, the results are much less conclusive. (Diss. Abstr. Int., B)

20047 HALF-LIVES OF ^{10}C, ^{14}O, AND ^{23}Mg. Azuelos, G.; Crawford, J. E.; Kitching, J. E. (McGill Univ., Montreal). Phys. Rev., C; 9: No. 3, 1213-1214(Mar 1974).

Half-lives of ^{10}C, ^{14}O, and ^{23}Mg were measured to be 19.28 ± 0.02, 70.43 ± 0.18, and 11.26 ± 0.08 s, respectively. (1 table) (auth)

20048 NUCLEAR-COULOMB INTERFERENCE IN $\pi^{+}-{}^{12}C$ SCATTERING. Mutchler, G. S. (Rice Univ., Houston, TX); Scott, M. L.; Fletcher, C. R. Phys. Rev., C; 9: No. 3, 1198-1199(Mar 1974).

The small-angle scattering of π^{+} from ^{12}C was measured at 115, 167, and 242 MeV from 3 to 10°. These measurements covered the Coulomb-nuclear interference region. New values of the $\pi^{+}-{}^{12}C$ total cross section were used to extract the real part of the forward-scattering amplitude. (1 table) (auth)

20049 ^{6}Li CLUSTER-MODEL PHENOMENOLOGY. Noble, J. V. (Univ. of Virginia, Charlottesville). Phys. Rev., C; 9: No. 3, 1209-1212(Mar 1974).

A phenomenological α + d cluster-model wave function for the ^{6}Li ground state is suggested, and its properties are fixed by using data on the static M1 and E2 moments and elastic charge form factors of ^{6}Li. The resulting α + d momentum distribution is then compared with that deduced from knock-out and transfer reactions. (2 figures, 1 table) (auth)

20050 ANGLE TRANSFORMATION FOR THE π-NUCLEUS OPTICAL POTENTIAL. Kujawski, E.; Miller, G. A. (Carnegie-Mellon Univ., Pittsburgh). Phys. Rev., C; 9: No. 3, 1205-1208 (Mar 1974).

The transformation of the π-nucleon T matrix from the π-nucleon to the π-nucleus center-of-mass systems is investigated. The correct angle transformation is presented, and it is shown to yield straightforward corrections to the usual Kisslinger and local Laplacian potentials consisting of terms proportional to $\nabla^{2}\rho$ and $\nabla^{4}\rho$, where ρ is the target density. Numerical results are presented for $\pi^{-}-{}^{12}C$ elastic scattering at 120 and 180 MeV lab kinetic energy. (2 figures, 1 table) (auth)

20051 DETECTION OF NEUTRON-EXCESS ISOTOPES OF LOW-Z ELEMENTS PRODUCED IN HIGH-ENERGY NUCLEAR REACTIONS. Bowman, J. D.; Poskanzer, A. M.; Koreteling, R. G.; Butler, G. W. (Univ. of California, Berkeley). Phys. Rev., C; 9: No. 3, 836-851(Mar 1974).

A search was made for new isotopes of the elements lithium through nitrogen produced in the high-energy (4.8-GeV) proton irradiation of a uranium target. The fragments were identified by ΔE-E and time-of-flight techniques. An electronic pulse-width discriminator greatly reduced the background allowing high sensitivity. A new method for analyzing time-of-flight data and a new algorithm for particle identification were introduced. Two new isotopes, ^{14}Be and ^{17}B, were observed to be particle stable and the existence of ^{19}C was confirmed. It was shown that ^{12}Li and ^{16}B are particle unbound. Approximate production cross sections were determined for ^{14}Be, ^{17}B, ^{18}C, and ^{19}C, and upper limits estimated for ^{13}Li, ^{19}B, ^{20}C, and ^{22}N. (auth)

20052 HIGH-LYING NEUTRON-HOLE STATES POPULATED IN THE REACTION ^{13}C(p,d)^{12}C AT 62 MeV. Parish, L. J. (Florida State Univ., Tallahassee); Brown, R. A.; Eberhard, K. A.; Richter, A.; von Witsch, W. Phys. Rev., C; 9: No. 3, 876-882(Mar 1974).

The single-nucleon pickup reaction ^{13}C(p,d)^{12}C at 62 MeV has been employed to study high-lying states in ^{12}C. States are seen at excitation energies E_x = 17.76, 18.80, 21.5, and 22.5 MeV in ^{12}C and the 1p neutron-hole strength found is in qualitative agreement with theoretical predictions. However, the 1p neutron-hole strength at high excitation is distributed over more states than predicted by intermediate-coupling shell-model calculations. (auth)

20053 EXCHANGE POTENTIAL BETWEEN NEARLY IDENTICAL NUCLEI. Yukawa, T. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., C; 9: No. 3, 864-875(Mar 1974).

In the framework of the microscopic theory of complex collisions the interaction between "nearly" identical nuclei, two nuclei which have nearly the same mass and whose common states of the core are to be considered identical, has been studied. The couplings between the elastic and other channels are neglected except those between different polarizations. The existence of the space-exchange potential is shown as the results of the core-exchange process as well as the exchange of valence particle(s). A simple model calculation has been done for the ^{16}O + ^{17}O system. The nature of the long-range part of the potential, especially the polarization dependence of the coupling potential, and the physical consequence of the space-exchange potential in the elastic scattering differential cross section are discussed. (auth)

20054 COMPOUND NATURE OF THE REACTION ^{12}C(^{14}N,^{6}Li)^{20}Ne. Hanson, D. L.; Stokstad, R. G.; Erb, K. A.; Olmer, C.; Bromley, D. A. (Yale Univ., New Haven). Phys. Rev., C; 9: No. 3, 929-934(Mar 1974).

It is found that the statistical model accounts rather well for the absolute cross sections measured recently for the reaction ^{12}C(^{14}N,^{6}Li)^{20}Ne at $E_{c.m.} \sim 24$ and ~36 MeV and for the integrated ^{7}Be yields observed in the ^{12}C + ^{14}N reaction at $E_{c.m.}$ = 16-28 MeV. These results demonstrate that compound-nucleus formation followed by the emission of complex particles such as ^{6}Li or ^{7}Be occurs with sizable cross sections in these reactions. (auth)

20055 STUDY OF T = 3/2 STATES IN ^{17}F. Skwiersky, B. M.; Baglin, C. M.; Parker, P. D. (Yale Univ., New Haven). Phys. Rev., C; 9: No. 3, 910-923(Mar 1974).

The first seven T = 3/2 states in ^{17}F have been studied as resonances in the ^{16}O + p entrance channel, observing the (p_0), (p_1 + p_2), (p_3 + p_4), and (α_0) exit channels. In a survey of the energy region E_p = 13.23 to 16.60 MeV in steps of less than 5 keV at six laboratory angles, the previously unobserved fourth and fifth T = 3/2 states were found at E_p = 13.271 ± 0.004 and 14.017 ± 0.004 MeV, respectively. Complete elastic scattering angular distributions (at 29 angles from θ_{lab} = 25 to 165°) were measured from E_p = 9.0 to 20.35 MeV in 50-keV steps and were analyzed using the optical-model code JIB3 to extract phase-shift information across this region. These results were used in a phase-shift analysis of the individual T = 3/2 resonances to obtain assignments for the second through the seventh T = 3/2 states in ^{17}F. (auth)

20056 $\mu^- + {}^6\text{Li} \rightarrow {}^3\text{H} + {}^3\text{H} + \nu$ WITH FINAL-STATE INTERACTIONS. Wienke, B. R. (Los Alamos Scientific Lab., NM); Meyer, S. L. Phys. Rev., C; 9: No. 3, 943-947(Mar 1974).

The capture $\mu^- + {}^6\text{Li} \rightarrow {}^3\text{H} + {}^3\text{H} + \nu$ is briefly reanalyzed using the current-current theory of weak interactions and a scattering representation for the final-state interactions between the outgoing tritons. Both the capture rate and symmetrized triton-energy distribution are estimated using asymptotic triton wave functions with nuclear phase shifts obtained from a resonating-group analysis of the ditriton system. We obtain a rate Γ = 141 sec^{-1}. (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 19940, 20025, 20047, 20051, 20066, 20074, 20077, and 20118.

20057 (RCN-203, pp 14-19) PROPERTIES OF NUCLEI IN THE A = 21 TO 44 REGION. Endt, P. M. (Rijksuniversiteit, Utrecht). Dec 1973.

From nuclear physics with thermal and resonance energy neutrons; Petten, Netherlands (22 May 1973).

A recent review on the A = 21 to 44 nuclei has provided copious material for the statistical evaluation of, e.g., γ- and β-transition probabilities. This leads to a discussion of the set of propositions on which strong arguments for spin and parity assignments are based as formulated by the Nuclear Data Group. In particular, the influence of isobaric spin is elaborated. (1 table) (auth)

20058 (RCN-203, pp 289-297) REACTION ^{29}Si(n,γ)^{30}Si. Spits, A. M. J. (FOM-RCN Nuclear Structure Group, Petten, Netherlands). Dec 1973.

From nuclear physics with thermal and resonance energy neutrons; Petten, Netherlands (22 May 1973).

The higher-lying states of ^{30}Si were investigated in two ways: singles gamma spectra were recorded following capture of unpolarized thermal neutrons in an isotopically enriched target; the circular polarization of three primary γ-ray transitions was measured by using a polarized-thermal-neutron beam. Capture cross sections for ^{28}Si and ^{29}Si were found to be 0.16 ± 0.03 and 0.10 ± 0.03 b, respectively. Reduced transition probabilities are compared with (d,p) stripping strengths. Spin assignments of some bound states in ^{30}Si are tabulated. The ^{30}Si level scheme is compared with that for ^{29}Si. (4 figures, 1 table) (RWR)

20059 (SUNI-28, pp 13-14) DIRECT EXCITATION OF THE ANALOGUE DIPOLE STATE IN ^{28}Al. Bharuth-Ram, K.; Perez, S. M.; Brooks, F. D., McMurray, W. R.; Wynchank, S. (Southern Universities Nuclear Inst., Faure, South Africa). 1973.

20060 STUDY OF THE STRUCTURE OF THE SILICON AND PHOSPHORUS ISOTOPES. Dykoski, W. W. S. Minneapolis; Univ. of Minnesota (1973). 186p. University Microfilms Order No. 74-10, 616.

Thesis (Ph. D.).

Differential cross sections were measured for the ^{28}Si(^{3}He, d)^{29}P and ^{29}Si(^{3}He, d)^{30}P reactions, and for elastic scattering of ^{3}He on ^{28}Si, ^{29}Si and ^{30}Si, at an incoming energy of 25 MeV. Spectra were taken with an Enge split-pole magnetic spectrometer at 19 angles each, up to an excitation energy of 7.5 and 8.7 MeV for ^{29}P and ^{30}P, respectively. The elastic scattering data were analyzed with the optical model to obtain ^{3}He potential parameters for use in the DWBA analysis of the reaction angular distributions, and to give an absolute normalization to the reaction data. New assignments of $J^\pi = 1^+$ were made to the 3731 and 5505-keV states of ^{30}P because these states were excited by a mixture of l = 0 and l = 2 transfers. $J^\pi = 3^-$, T = 1 was assigned to the 6092-keV state because its excitation energy and strength agree with that expected for the analog of the 5490-keV state in ^{30}Si. In general, previous spin assignments were confirmed. Spectroscopic strengths were extracted and those for ^{30}P compared favorably to shell model calculations, while those for ^{29}P showed fair agreement to strengths (and excitation energies) from the ^{28}Si(d, p)^{29}Si reaction. This indicates the validity of a modified DWBA to slightly unbound states in ^{29}P, which we applied. Total spectroscopic strengths were compared to sum rule limits. A quantitative estimate for the nonclosure of the $1d_{\frac{3}{2}}$ shell in ^{28}Si and ^{29}Si was extracted. Matrix elements of the effective n-p interaction (T = 0 and T = 1) were experimentally determined for ^{30}P (two nucleons outside a ^{28}Si core) by using mass difference formulas and the centroid of excitation energies of states, which were assumed to have components of the $(2s_{\frac{1}{2}})^1_{\frac{1}{2}+}{}_{,1+}$, $(1d_{\frac{3}{2}})^1 \otimes (2s_{\frac{1}{2}})^1_{\frac{1}{2}+}{}_{,2+}$, and $(1f_{\frac{7}{2}})^1 \otimes (2s_{\frac{1}{2}})^1_{\frac{1}{2}-}{}_{,4-}$ configurations. Spectroscopic steengths were used as weighting factors. Surprisingly good agreement was found when these matrix elements were compared to those calculated in a two-particle shell model. (Diss. Abstr. Int., B)

20061 STUDY OF SEVERAL ODD-ODD S-D SHELL NUCLEI VIA THE (p, d) REACTION AT 35 MeV. Rice, J. A. East Lansing, Mi; Michigan State University (1973). 181p. University Microfilms Order No. 74-6115.

Thesis (Ph. D.).

States in ^{22}Na, ^{34}Cl, ^{36}Cl, and ^{38}K were studied via the (p, d) reaction at an incident proton energy of 35 MeV. Levels to 6 MeV of excitation in ^{22}Na, ^{34}Cl, and ^{38}K and to 8 MeV in ^{36}Cl were

observed; and excitation energies, assigned to an accuracy of ≤1 keV per MeV. Angular distributions were measured from 3° to 60°, with special emphasis on the region from 3° to 35°. This allowed a precise definition of the forward angle shapes for l = 0 and l = 2 single neutron pickup angular distributions in the s–d shell. A careful screening of deuteron optical-model parameters available from the literature was conducted in an effort to reproduce the experimentally observed shapes via distorted-wave Born-approximation calculations. The best overall fits to pure l-transfer distributions for the A > 30 nuclei were obtained with standard finite-range, nonlocality-corrected calculations which include a density-dependent damping of the V_{pn} interaction. A good l = 0 fit to the ^{23}Na(p, d)^{22}Na data could not be obtained for calculations which also yielded good fits for the A > 30 nuclei. Spectroscopic factors, l values and parity assignments, and excitation energies are compared with previous experimental studies and recent shell-model calculations. The agreement between the present experimental results and theoretical predictions is good for low-lying levels in the residual nuclei, but observed l = 3 angular distributions and spectroscopic factors for higher excited states indicate a need for consideration of 2 (or 4 or 6-) particle excitations to the f–p shell in the ground-state configurations of the A > 30 target nuclei. (Diss. Abstr. Int., B)

20062 THERMAL NEUTRON CAPTURE STUDIES OF SOME LIGHT ODD–ODD NUCLEI. Ishaq, A. F. M. Hamilton, Ont.; McMaster Univ. (1972). National Library of Canada, Ottawa.

Thesis (Ph. D.).

Thermal-neutron capture studies were made of the odd–odd nuclei ^{20}F, ^{24}Na, ^{28}Al, ^{32}P, ^{36}Cl, and ^{40}K. The gamma-ray spectra were studied by using a Ge(Li) pair spectrometer, and revised decay schemes are presented for these nuclei. The Q values and gamma-ray multiplicities were obtained for the reactions studied. The average partial widths for primary M1 and E1 transitions were calculated for the six nuclei and compared with the theoretical estimates. The features of the capture gamma-ray spectra are discussed; and it is observed that, for the six nuclei studied, the total intensity in the spectrum above the energy of 0.3 times the Q-value is nearly the same (~1.4 photons/capture). (Diss. Abstr. Int., B)

20063 STUDY OF THE ^{24}Mg(d,n) REACTION FROM 2.5 TO 4.0 MeV. Nerbun, R. C. Jr. Cleveland, OH; Case Western Reserve Univ. (1973). 82p. University Microfilms Order No. 74-10,810.

Thesis (Ph. D.).

Cross sections of neutron groups from the ^{24}Mg(d,n)^{25}Al reaction leading to the ground and first and second excited states of ^{25}Al were measured in the deuteron energy range from 2.5 to 4.0 MeV. Excitation functions were measured at laboratory angles of 0°, 40°, and 110°, and angular distributions were measured at incident deuteron energies of 3.00, 3.50, and 4.00 MeV. The deuteron beam was produced by a 4MV pulsed-terminal accelerator, and the neutron cross sections were measured with time-of-flight techniques. Calculations were performed to determine to what extent DWBA theory, with a single-particle-model description for the residual nucleus, could describe the experimental results. Compound-nucleus contributions were estimated and taken into account to obtain a better agreement between theory and experiment. Spectroscopic factors were extracted by fitting the theoretical cross sections to the absolute cross section measurements. (Diss. Abstr. Int., B)

20064 STUDY OF THE ^{28}Si(^{3}He,n)^{30}S REACTION BETWEEN 3.7 AND 4.2 MeV. Kogan, A. Cleveland, OH; Case Western Reserve Univ. (1973). 104p. University Microfilm Order No. 74-10,798.

Thesis (Ph. D.).

The differential cross section for the ^{28}Si(^{3}He,n)^{30}S reaction was measured for reaction energies ranging from 3.7 to 4.2 MeV. A Van de Graaff accelerator was employed in the measurements, performed with time-of-flight techniques. Two excitation functions, at laboratory angles of 0° and 65°, and three angular distributions, at laboratory reaction energies of 3.94, 4.04 and 4.24 MeV, were determined; the transitions were observed leading to both the ground and first excited states of the residual nucleus. A set of DWBA calculations in which the reaction was assumed to proceed through a double stripping mechanism, followed by an analysis based on a coherent sum of direct-reaction and compound-nucleus amplitudes, was carried out. With the latter it was possible to introduce a certain improvement in the description of the experimental results. An upper limit of the spectroscopic factor for the first excited state of ^{30}S relative to that for the ground state was determined, and the value for that limit was found to be 0.21 with a relative uncertainty of ±50%. (Diss. Abstr. Int., B)

20065 SPIN AND PARITY ASSIGNMENTS FOR ^{33}S LEVELS FROM THE ^{29}Si(α,n$_0$)^{32}S REACTION. Sanin, L. G. Lowell, MA; Lowell Technological Inst. (1973). 109p. University Microfilms Order No. 74-7913.

Thesis (Ph. D.).

In excitation functions measured at 0° and 160° in 5-keV steps between E_α = 3.5 and 5.5 MeV for the ^{29}Si(α,n$_0$)^{32}S reaction, sharp resonances were located corresponding to ^{33}S levels at excitation energies between 10.190 and 11.980 MeV. Forty-one on-resonance neutron angular distributions were measured and normalized to an absolute cross-section scale. Spin-½, -3/2, -5/2 and -7/2 states in ^{33}S were identified via the characteristic shape of the single-level angular distributions. An analysis employing coherently admixed two-level theory complementing the shape analysis furnished spin and parity assignments to single state resonances and twin-level resonances. An optical potential of the Woods–Saxon volume-absorption type was deduced for alpha particles; it provided good results at E_α = 2.0 to 6.0 MeV on the nuclei ^{13}C, ^{29}Si, and ^{31}P, both for alpha scattering data and for the two-level analysis of the ^{13}C(α,n$_0$)^{16}O, ^{29}Si(α,n$_0$)^{32}S, and ^{31}P(α,p)^{34}S reactions. (Diss. Abstr. Int., B)

20066 (n–γ) DIRECTIONAL CORRELATION IN THE REACTION ^{20}Ne(d,nγ)^{21}Na(E^* = 330 keV). Hofmann, R.; Corfu, R.; Rossel, J. (Univ., Neuchatel, Switzerland). Helv. Phys. Acta; 46: No. 5, 670-679(1973).

Time-of-flight measurements of neutron–gamma directional correlation were performed in two different geometric arrangements for the 330-keV, first excited state of ^{21}Na. From the deduced multipole mixing parameter, δ, and the known lifetime, τ, the characteristics of the low lying energy level can be determined and discussed. The assignment $5/2^+$ is established on the basis of a γ transition probability amounting to ~40 Weisskopf units. These results favor the nuclear model of collective rotational bands with Coriolis coupling for the low-lying levels of the 21-nucleon system. (6 figures, 2 tables) (auth)

20067 SHORT-RANGE CORRELATIONS IN (d,p) STRIPPING REACTIONS. Osman, A.; Zaky, M. (Univ., Cairo). Nuovo Cim.; 22A: No. 3, 345-356(1 Aug 1974).

Due to the strong repulsion between nucleons at very short distances, the short-range correlations were investigated. The nucleon–nucleon interaction is taken as a short-range repulsive core surrounded by a long-range attractive potential to take these short-range correlations into account. The differential cross sections for (d,p) stripping reactions are calculated using DWBA which are fitted with experimental angular distributions to extract spectroscopic factors. From these calculations it is shown that, taking into account the repulsive-core effects in (d,p) stripping reactions, the exact spectroscopic factors are extracted. (auth)

20068 STUDY OF HIGH-SPIN CONTINUUM STATES IN ^{20}Ne AND ^{24}Mg. Fifield, L. K. Philadelphia; Univ. of Pennsylvania (1973). 186p. University Microfilms Order No. 74-14,059.

Thesis (Ph. D.).

A new angular correlation technique was developed for assigning spins to states that are selectively populated in reactions of the type ^{12}C(^{12}C,α)^{20}Ne and which decay by α-particle emission to a state of nonzerc spin, which decays in turn to a spin-zero state by the emission of a γ-ray. Such states are not accessible to conventional particle–particle angular correlation techniques. The new method consists of measuring the triple angular correlation of the two α particles and the γ ray from the reaction ^{12}C(^{12}C,$\alpha_1\alpha_2\gamma$)^{16}O with the first emitted α-particle observed at zero degrees, the γ-ray observed at a fixed angle, and the second emitted α-particle observed over a range of angles. The spins of two states in ^{20}Ne, at 15.18 MeV (6^+) and 17.40 MeV (9^-), were determined with this method. The 17.40-MeV state was identified as the 9^- member of the lowest negative-parity band in ^{20}Ne; the 6^+ assignment to the level at 15.18 MeV is in disagreement with an earlier assignment of 9^- to this level. The triple correlation method was also applied to the determination of the spins and parities of several states in ^{24}Mg. These states were selectively populated in the ^{16}O(^{12}C,α)^{24}Mg reaction and decayed by α-particle emission to the 1.63-MeV (2^+) state in ^{20}Ne. The results are as follows: 13.42 MeV, 6^+, 13.84 MeV, 6^+; 14.14 MeV, 8^+; 15.15 MeV, 7^-; 16.30 MeV, 8^+; 16.55 MeV, $8^+ + 9^-$; 16.84 MeV, 8^+. In addition, the spins of the following states were determined from the angular correlations of α particles leading to the ^{20}Ne ground state: 12.83 MeV, 6^+; 13.75 MeV, 5^-; 16.46 MeV, 7^-. A search was made for particle decays of the 11.86-MeV (6^+, 8^+) and 13.20-MeV (8^+) states in ^{24}Mg; no particle decay branch was found for either state. Statistical-model calculations were performed to investigate the usefulness of such calculations in assigning spins to states selectively populated in the ^{16}O(^{12}C,α)^{24}Mg and ^{12}C(^{16}O,α)^{24}Mg reactions. (Diss. Abstr. Int., B)

20069 NUCLEAR STRUCTURE CALCULATION FOR ^{27}Al AND ^{28}Si. Behrman, R. H. Montreal; McGill Univ. (1971). 172p.

Thesis.

Nuclear shell model calculations are performed for ^{27}Al and ^{28}Si. For ^{27}Al the calculated spectrum, electromagnetic properties, spectroscopic factors and β-decay rates are compared with experiment. Very good overall agreement is obtained. A more extensive shell model calculation is performed for ^{28}Si and the results are compared with experiment. A good account is given of the observed electromagnetic and β-decay data, although only fair agreement between the shell model and experimental spectra is obtained. (auth)

20070 CONTRIBUTION TO THE STUDY OF SINGLE NUCLEON TRANSFER REACTIONS ON SOME 2s–1d SHELL NUCLEI. Kroon, J. C. Ottawa; Univ. of Ottawa (1971). 127p.

Thesis.

Angular distributions of deuterons from the ^{26}Mg(p,d)^{25}Mg, ^{27}Al(p,d)^{26}Al at 20 MeV and ^{37}Cl(p,d)^{36}Cl, ^{23}Na(p,d)^{22}Na at 19 MeV have been measured. Angular distributions in ^{25}Mg up to 3.903 MeV excitation were compared with distorted wave predictions. A spectroscopic factor analysis was carried out based on the Nilsson Model where ^{25}Mg was assumed to consist of a deformed core with the odd neutron in a mixture of all possible N ± 2 Nilsson states. The theory was extended to include Coriolis band mixing among all 2s–1d shells. The $\frac{1}{2}^+$ and $\frac{3}{2}^+$ levels were populated more strongly than predicted by single-step direct neutron pick-up theory. Altogether 30 levels were resolved in the ^{27}Al(p,d)^{26}Al reaction. The strongest transitions were compared with distorted wave predictions and further analyzed using the Nilsson and shell model. The level at 4.699 MeV was identified as the isobaric analog to the 4.331 MeV state in ^{25}Mg. Angular distributions in ^{36}Cl up to 4.292 MeV excitation were analyzed using distorted wave predictions. A detailed comparison is made between experimentally extracted spectroscopic factors and theoretical spectroscopic factors derived from $2s_{\frac{1}{2}}-1d_{\frac{3}{2}}$ and $1d_{\frac{5}{2}}-2s_{\frac{1}{2}}-1d_{\frac{3}{2}}$ shell model wave functions. Transitions to states in ^{22}Na were compared with distorted wave predictions. The data were analyzed using the Nilsson model. The analysis shows a new level at 4.294 MeV. (auth)

20071 DECAYS OF ^{21}Na, ^{23}Ne, ^{23}Mg, ^{24}Ne, AND ^{31}S. Alburger, D. E. (Brookhaven National Lab., Upton, NY). Phys. Rev., C; 9: No. 3, 991-995(Mar 1974).

The radioactive decays of ^{21}Na, ^{23}Ne, ^{23}Mg, ^{24}Ne, and ^{31}S have been studied using Ge(Li) and plastic scintillation detectors to measure γ and β rays. ^{21}Na, ^{23}Ne, and ^{24}Ne were formed by bombarding a neon target with 3-MeV deuterons or tritons, followed by gas transfer to a remote counting station. ^{23}Mg and ^{31}S were made in (p,n) reactions using 10-MeV protons from an MP tandem Van de Graaff together with a rabbit target-transfer facility. The following half-lives (in sec) were obtained: ^{21}Na, 22.55 ± 0.10; ^{23}Ne, 37.24 ± 0.12; ^{23}Mg, 11.36 ± 0.04; and ^{31}S, 2.605 ± 0.012. Relative β-ray intensities were derived from the measured γ-ray intensities. The various branching results are in reasonable agreement with previous work except for ^{21}Na whose measured β^+ branch of 5.1 ± 0.2% to the 350-keV state of ^{21}Na is a factor of 2 larger than earlier reports. However, the result is in excellent agreement with an estimate by Wilkinson. (auth)

20072 HIGH-SPIN STATES IN ^{39}K FROM ^{24}Mg(^{18}O,p2n$\gamma\gamma$ . . .)^{39}K. Kolata, J. J.; Gorodetzky, P.; Olness, J. W.; Poletti, A. R.; Warburton, E. K. (Brookhaven National Lab., Upton, NY). Phys. Rev., C; 9: No. 3, 953-964(Mar 1974).

The electromagnetic decays of several high-spin states in ^{39}K were studied via heavy-ion-induced reactions involving ^{18}O and ^{19}F bombardments of targets of ^{24}Mg, ^{26}Mg, and ^{27}Al. The ^{39}K states were formed most strongly in the ^{24}Mg(^{18}O,p2n$\gamma\gamma$...)^{39}K reaction which provided the main body of quantitative evidence we report. The identification of specific transitions in ^{39}K, and the resultant decay scheme, are based on Ge(Li) $\gamma-\gamma$ coincidence spectra and also on γ-ray yield curves measured for $20 \leq E_x \leq 61$ MeV. Lifetimes of ^{39}K states were measured by the recoil distance method. These lifetimes together with γ-ray angular distributions restrict the allowable spin-parity assignments and multipole mixing ratios for the transitions studied. Arguments based on the proposed reaction mechanism are invoked to give a most probable decay scheme for the high-spin states involved. The resulting data provide new information on the high-spin structure of ^{39}K and also illustrate the power of these heavy-ion-induced compound-nucleus reactions as spectroscopic tools for the investigation of high-spin states in light nuclei. (auth)

20073 REACTION ^{23}Na(α,p)^{26}Mg FROM E_α = 2.3 TO 3.7 MeV. Whitmire, D. P.; Davids, C. N. (Univ. of Texas, Austin). Phys. Rev., C; 9: No. 3, 996-1001(Mar 1974).

Integrated excitation functions for the reactions ^{23}Na(α,p_0)^{26}Mg and ^{23}Na(α,p_1)^{26}Mg* were measured over the energy range E_α = 2.3–3.7 MeV. Absolute resonance strengths were determined for 30 new p_1 resonances and 9 new p_0 resonances. The corresponding stellar reaction rate $N_A\langle\sigma V\rangle$ is recalculated and found to be enhanced by a factor of 3 at T_9 = 2 and by a factor of 4 at T_9 = 3. A multiparameter analytic fit to the new $N_A\langle\sigma V\rangle$ as a function of temperature over the range T_9 = 0.3–5.0 is given. The enhanced rate was incorporated in a nucleosynthesis code and the resulting change in ^{23}Na and ^{26}Mg abundances at selected temperatures is discussed. (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 19477, 19988, 20026, 20057, 20061, 20062, 20067, 20100, 20113, 20118, 20209, 20218, and 20225.

20074 (COO-3494-12, pp 12-24) HEAVY ION FUSION REACTIONS. Scobel, W.; Gutbrod, H. H.; Mignerey, A.; Blann, M. 1974.

In nuclear reaction mechanisms.

20075 (SUNI-28, p 14) HIGH-RESOLUTION MEASUREMENT OF THE NEUTRON TOTAL CROSS SECTION OF IRON FROM 24 keV TO 1000 keV. Pattenden, N. J. (Atomic Energy Research Establishment, Harwell, Eng.); Belcher, I. T.; Blair, I. M.; Bowen, P. H.; Cox, G. C.; Dolley, P. E.; McMurray, W. R. 1973.

20076 (SUNI-28, pp 16-18) PARAMETERS OF THE LEVELS OF ^{43}Sc AND ^{55}Mn. Buitendag, J. J.; van der Merwe, J. C.; Naude, W. J.; Rust, N. J. A.; Koen, J. W. (Southern Universities Nuclear Inst., Faure, South Africa). 1973.

20077 (SUNI-28, pp 18-19; 20) LIFETIME MEASUREMENTS USING THE PLUNGER METHOD. Buitendag, J. J.; Naude, W. J. (Southern Universities Nuclear Inst., Faure, South Africa). 1973.

20078 HARTREE–FOCK–BOGOLYUBOV-TYPE CALCULATIONS FOR EVEN–EVEN CALCIUM ISOTOPES Boschan, P. (Lorand Eotvos Univ., Budapest). Acta Phys. Acad. Sci. Hung.; 36: No. 1, 69-75(1974).

In the framework of the Hartree–Fock–Bogoliubov theory nuclear sizes and shapes are calculated starting with a local density independent central effective two body interaction. Spin-orbit forces are taken into account approximately. No energy gap is found in the case of double magic nuclei. For other even-even calcium isotopes there is a gap in the proton spectrum. The calculated and experimental energy gap values are in agreement. In the case of a superfluid type solution all examined isotopes get a spherical shape. (auth)

20079 STUDIES OF PROTON SCATTERING BY ^{40}Ca. Jurgensen, T. M. Houston, TX; Rice Univ. (1973). 232p. University Microfilms Order No. 73-21,565.

Thesis (Ph. D.).

An optical-model parameterization of proton scattering by ^{40}Ca was determined that describes well both low-energy (E_p <5 MeV) structural features of ^{41}Sc and higher-energy (12 MeV < E_p < 22 MeV) scattering cross sections and polarizations. An interesting feature of the parameterization is the location of the f 5/2 shape elastic resonance at $E_p \approx 6.5$ MeV. This result furnishes a key to the understanding of the behavior of both the proton-capture and -scattering cross sections, in the neighborhood of this energy, that previously had been intractable to analysis. In particular, application of the Lane–Robson formalism allows the cross sections to be accounted for, primarily, through the coupling of four strong $5/2^-$ compound-nucleus resonances and the f 5/2 shape resonance. By using optical-model cross sections to describe a shape elastic component it was possible to extract the compound elastic cross sections from a large body of differential cross section data, part of which was measured in the course of this study. Analysis, with a Hauser–Feshbach technique, of the compound elastic and inelastic scattering to the first four excited states of ^{40}Ca yielded adequate agreement in the cross section magnitudes, although structural features were not properly described. (Diss. Abstr. Int., B)

20080 ISOBARIC-ANALOGUE RESONANCE STATES IN THE ^{56}Fe NUCLEUS. El-Kazzaz, S. A.; Abdel-Harith, M.; El-Nadi, L. M. (Univ. of Cairo). Ann. Phys. (Leipzig); 29: No. 4, 341-350(1973).

Gamma-ray spectra from the reaction $^{55}Mn(p,\gamma)^{56}Fe$ were measured at the isobaric analog resonances at E_p = 1769 ± 4 keV and 1806 ± 4 keV with a 15-cm³ Ge(Li) detector. Double correlation for the transition from the resonance level to the second excited state of ^{56}Fe was measured for the two cases. Proton elastic scattering was also studied at each resonance at 150°. Analysis of (p,γ) and (p,p) yields a J^π assignment 4^+ or 5^+ and 3^+ for the two mentioned resonance states, respectively, which are the isobaric analogs of the 0.454-MeV and 0.486-MeV states of ^{56}Mn. The proton partial width and the total width for each resonance state were also determined. (6 figures, 4 tables) (auth)

20081 EXCITATION FUNCTIONS OF ^{51}V, ^{56}Fe, $^{65}Cu(p,n)$ REACTIONS BETWEEN 10 AND 45 MeV. Gadioli, E.; Grassi Strini, A. M.; Lo Bianco, G.; Strini, G.; Tagliaferri, G. (Univ., Milan). Nuovo Cim.; 22A: No. 4, 547-558(21 Aug 1974).

The (p,n) reaction cross-sections of ^{51}V, ^{56}Fe and ^{65}Cu have been measured, for incident-proton energies ranging from 10 to 45 MeV, in steps of 2 MeV. The excitation curves exhibit the usual changes in slope consistent with the expectation that the high-energy tails are mainly due to pre-equilibrium neutron emission. These changes occur for proton energies around 20 MeV, a value in accord with the result previously obtained for reactions of the same type in heavier nuclei. A detailed analysis of the excitation curves has been performed under the hypothesis of incoherent addition of the contributions from compound-nucleus evaporation and pre-equilibrium emission. It is concluded that calculations, based, for the pre-equilibrium contribution, on the exciton model, can give results in satisfactory agreement with the experiment even for nuclei with mass numbers as low as A ≃ 50. (auth)

20082 HIGH RESOLUTION STUDY OF PROTON RESONANCES IN ^{41}Sc, ^{43}Sc, AND ^{45}Sc. Wilson, W. M. Jr., Durham, NC; Duke Univ. (1973). 278p. University Microfilms Order No. 74-13,501.

Thesis (Ph. D.).

Excitation functions were measured for $^{40}Ca(p,p)$ from 1.8 to 2.9 MeV, $^{42}Ca(p,p)$ from 1.2 to 3.0 MeV, and $^{44}Ca(p,p)$ from 1.5 to 3.0 MeV at laboratory angles of 160°, 135°, 105°, and 90°. Excitation functions were also measured for $^{44}Ca(p,p_1)$ $^{44}Ca^*$ from 2.6 to 3.0 MeV at 160°, 135°, and 105°. The resonances observed in the excitation functions were analyzed in terms of the parameters of the R-matrix theory. Spins, parities, total widths and partial widths were extracted for 5 resonances in ^{42}Sc, 170 resonances in ^{43}Sc, and 429 resonances in ^{45}Sc. Coulomb displacement energies were extracted for all the observed analog states. Spectroscopic factors were calculated for each observed analog state. Each of the five analog states observed in ^{45}Sc was fragmented; fits to the theoretical fine structure distribution were obtained for four of them. Nearest-neighbor spacing distributions were calculated for single and superposed sequences and plotted for comparison with the theoretical distributions. The Dyson F-statistic was calculated for the $\frac{1}{2}^+$ and $\frac{1}{2}^-$ levels in ^{43}Sc and ^{45}Sc. Width distributions were calculated for the $\frac{1}{2}^+$ and $\frac{3}{2}^-$ levels in ^{43}Sc. Proton strength functions were calculated for the s- and p-wave resonances in ^{43}Sc and ^{45}Sc. (RWR)

20083 (^3He,p) REACTION STUDIES IN THE $f_{\frac{7}{2}}$ SHELL. Caldwell, T. A. Philadelphia; Univ. of Pennsylvania (1973). 157p. University Microfilms Order No. 74-14,035.

Thesis (Ph. D.).

The $^{48}Ti(^3He,p)^{50}V$, $^{50}Ti(^3He,p)^{52}V$, and $^{54}Cr(^3He,p)^{56}Mn$ reactions were studied at 15 MeV; reaction products were momentum analyzed in a multiangle spectrograph. An absolute cross-section scale was established by means of $^3He^{++}$ Rutherford scattering. The energy resolution of 17–25 keV permitted the identification of up to one hundred levels reaching 7.5 MeV in excitation in each of the three residual nuclei. Proton angular distributions were extracted for the stronger states. Comparison with predictions of the two-nucleon-transfer code TWOPAR allowed assignment of the transferred orbital angular momentum with a large degree of certainty in the case of even L values. Criteria for distinguishing L = 0 and L = 0 + 2 transitions to 0^+ and 1^+ levels, respectively, were derived; many new 1^+ states were identified by this means. The total 1^+ strength in ^{50}V, ^{52}V, and ^{56}Mn appears to be greater than expected within a 1f–2p configuration space, the enhancement factor being similar to that found recently for ^{48}Sc and ^{50}Sc. There are indications that this enhancement may be a general feature of nuclei in this mass region. The intensities of the $0^+ \rightarrow 0^+$ transitions leading to isobaric analog and anti-analog states were compared with predictions of the pairing-vibrational model with isospin. The ratio of antianalog to analog strength was found to be much less than expected in this model. (Diss. Abstr. Int., B)

20084 INELASTIC PROTON SCATTERING TO THE LOWEST 1^+ STATE IN ^{58}Ni. Geramb, H. V.; Amos, K. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Theoretische Kernphysik). Z. Phys.; 26: No. 5, 367-370(May 1974).

1 fig.; 10 refs.

A microscopic, antisymmetrized Distorted Wave approximation is used in an analysis of the inelastic scattering of 17.8 MeV protons from ^{58}Ni in which the 1^+(2.90 MeV) state is excited. Two-step resonance amplitudes complement the usual direct reaction transition amplitudes in this analysis. In particular, resonance amplitudes associated with the virtual excitation of a giant dipole and of a giant octupole resonance are considered, and are essential for the model to explain the experimental data fully. (auth)

20085 LIFETIME MEASUREMENTS AND E2 EFFECTIVE CHARGES FOR NUCLEI IN THE $1f_{\frac{7}{2}}$ SHELL. Brown, B. A.; Fossan, D. B.; McDonald, J. M.; Snover, K. A. (State Univ. of New York, Stony Brook). Phys. Rev., C; 9: No. 3, 1033-1053 (Mar 1974).

Lifetimes for a number of levels in nuclei with 40 < A < 56 were measured by using the recoil-distance technique. The experimental results for the mean lifetimes are 45^{+10}_{-10} ps for the 1491-keV 3^+ and 57 ± 10 ps for the 1511-keV 5^+ levels in ^{42}Sc; 8.1 ± 1.1 ps for the 2987-keV $15/2^-$ level in ^{43}Sc; 19.6 ± 1.7 ps for the 3285-keV 6^+ level in ^{44}Ca; 12.8 ± 1.2 ps for the 3334-keV 6^+ level in ^{48}Ti; 5.1 ± 1.0 ps for the 1021-keV $11/2^-$ level in ^{49}V; 12.6 ± 2.1 ps for the 783-keV 2^+ level in ^{50}Cr; 20.4 ± 3.3 ps for the 238-keV $7/2^-$ level in ^{51}Mn; $13.7^{+3.3}_{-3.3}$ ps for the 2369-keV 4^+_1, 59.5 ± 3.3 ps for the 3114-keV 6^+, and 10.4 ± 1.2 ps for the 3469-keV (3^+,5^-) levels in ^{52}Cr; 15.5 ± 1.8 ps for the 2563-keV $13/2^-$ and 3.9 ± 0.6 ps for the 2693-keV $15/2^-$ levels in ^{53}Mn; and 5.7 ± 1.2 ps for the 2538-keV 4^+ level in ^{54}Fe. Lifetime limits were found for eight additional levels in these nuclei. In addition, an improved value, τ = 68.3 ± 3.1 ps, was obtained for 937-keV 3^+ level in ^{18}F. The B(E2) strengths for transitions in nuclei with 42 ≤ A ≤ 44 are collected and interpreted in terms of isospin-dependent effective charges using wave functions for the $(1f_{\frac{7}{2}})^n$, and $(fp)^n$, and $(fp)^{n+m}(sd)^{-m}$ model spaces. The core-polarization charges obtained from an analysis using $(fp)^2$ + $(fp)^4(sd)^{-2}$ wave functions are e_p = 1.16 ± 0.16 and e_n = 0.45 ± 0.03. Core-deformation effects are found to enhance the isoscalar but not the isovector effective charges for states with low spin. The B(E2) strengths for transitions in the isotones with 28 neutrons are also collected and interpreted by using $(1f_{\frac{7}{2}})^n$ wave functions. The effective proton charge is found to be approximately constant for all transitions with e_p = 1.8–2.0. Estimates of effective proton charges for these nuclei resulting from the use of larger model spaces are discussed; an approximate comparison for the whole 40 < A < 56 region is thereby permitted. (22 figures, 4 tables) (auth)

20086 K-SHELL INTERNAL-IONIZATION PROBABILITIES IN NUCLEAR β^- DECAY. Hansen, H. H.; Parthasaradhi, K. (EURATOM, Geel, Belgium). Phys. Rev., C; 9: No. 3, 1143-1147 (Mar 1974).

Total K-shell internal-ionization probabilities have been determined by x-ray spectroscopy with a high-energy-resolution Si(Li) detector for the β^--decaying isotopes ^{45}Ca, ^{85}Sr, ^{90}Sr, ^{90}Y, ^{99}Tc, ^{147}Pm, and ^{185}W. The number of emitted K x rays were measured in comparison to the absolute β^--decay rate. The results are compared with earlier experimental values and recent theoretical calculations of Law and Campbell. Good agreement is found between theory and experiment. (auth)

20087 MICROSCOPIC, NONHARMONIC DESCRIPTION OF ROTATIONS AND PAIRING VIBRATIONS IN DEFORMED pf-SHELL NUCLEI. Allaart, K.; Goeke, K.; Muether, H.; Faessler, A. (Kernforschungsanlage, Juelich, Ger.). Phys. Rev., C; 9: No. 3, 988-990(Mar 1974).

Angular-momentum- and particle-number-projected self-consistent Hartree-Bogoliubov wave functions are used within the generator-coordinate method for the description of excited states in ^{48}Ti and ^{56}Fe. Bands based on the ground state and first pairing-vibrational state respectively are studied. In the ground band of ^{56}Fe an antipairing effect occurs parallel with an increase of correlations in the excited band, so that for higher J the ground band becomes less paired than the excited one. (auth)

20088 (^6Li,d) REACTION ON ^{40}Ca. Strohbusch, U. (Argonne National Lab., IL); Fink, C. L.; Zeidman, B.; Markham, R. G.; Fulbright, H. W.; Horoshko, R. N. Phys. Rev., C; 9: No. 3, 965-972(Mar 1974).

The $^{40}Ca(^6Li,d)^{44}Ti$ reaction was studied at $E(^6Li)$ = 32 MeV. Angular distributions for ^{44}Ti levels up to 9-MeV excitation energy have been measured. They are compared with α-transfer distorted-wave Born-approximation calculations to determine angular momentum transfers and relative strengths. (auth)

20089 ELASTIC SCATTERING OF 60-MeV ALPHA PARTICLES BY THE EVEN NICKEL ISOTOPES. Madland, D. G. (Indiana Univ., Bloomington); Schwandt, P.; Sloan, W. T.; Shapiro, P.; Singh, P. P. Phys. Rev., C; 9: No. 3, 1002-1017(Mar 1974).

An optical-model analysis of the scattering of 60-MeV α particles by ^{58}Ni, ^{60}Ni, ^{62}Ni, and ^{64}Ni has been performed with particular emphasis placed on (1) the significance of the backward-angle data with respect to removal of potential ambiguities and (2) the extent to which α elastic scattering at this energy is sensitive to the interior detail of the potential. In the ^{58}Ni case, six equivalent potentials are found to fit the diffraction scattering region ($\theta < 70°$), but only two of these simultaneously provide acceptable fits in the backward-angle region. It is shown that the detailed form of the real potential significantly affects the scattering only at distances beyond ~4 fm. The 60-MeV α probe is not sensitive to the detail of the total potential inside of ~3 fm in any way that affects the elastic cross section. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 20074, 20086, 20089, 20112, 20113, 20118, 20120, 20218, and 20227.

20090 (COO-2184-6, pp 28-29) SPALLATION OF COPPER BY 3.9-GeV ^{14}N AND 3.9-GeV PROTONS. Cumming, J. B. (Brookhaven National Lab., Upton, NY); Haustein, P. E.; Stoenner, R. W.; Mausner, L.; Naumann, R. A. 26 Jun 1974.

In nuclear chemistry project.

20091 (COO-2184-6, pp 30-33) BETA DECAY OF ^{60}Zn. Lind, J.; Ansaldo, E.; Garvey, G.; Naumann, R. A. 26 Jun 1974.

In nuclear chemistry project.

20092 (RCN-203, pp 319-332) REVIEW OF NUCLEAR ORIENTATION TECHNIQUES APPLIED IN EXPERIMENTS WITH LOW-ENERGY NEUTRONS. Postma, H. (Rijksuniversiteit, Groningen, Netherlands). Dec 1973.

From nuclear physics with thermal and resonance energy neutrons; Petten, Netherlands (22 May 1973).

After a general introduction on the determination of level spins through the use of gamma correlations, a brief description of nuclear orientation is given. Then some static methods for achieving nuclear orientation are discussed; one method in particular is the use of the interaction of the electric quadrupole moment with electric field gradients. Two methods of routinely producing temperatures as low as 0.01 K are adiabatic demagnetization and dilution of concentrated liquid ^{3}He in liquid ^{4}He. Finally, three applications in low-energy neutron experiments with oriented nuclei are considered: study of resonance spins, capture gamma rays from oriented nuclei, and fission of aligned heavy nuclei. (5 figures) (RWR)

20093 (SUNI-28, pp 9-10) LEVEL STRUCTURE OF ^{75}As. McMurray, W. R.; Celliers, P. J.; Saayman, R. (Southern Universities Nuclear Inst., Faure, South Africa). 1973.

20094 (SUNI-28, pp 15; 16) PROPERTIES OF EXCITED LEVELS IN ^{65}Zn. van Heerden, I. J.; van Reenen, R. J.; Pilcher, J. V. (Southern Universities Nuclear Inst., Faure, South Africa). 1973.

20095 INVESTIGATION OF LEVELS IN ^{65}Ni USING THE ^{64}Ni(d VECTOR, p)^{65}Ni REACTIONS AND ^{64}Ni(p VECTOR, p)^{64}Ni SCATTERING NEAR ISOBARIC ANALOG RESONANCES. Tyler, J. V. Madison, WI; University of Wisconsin (1973). 179p. University Microfilms Order No. 74-28 359.

Thesis (Ph. D.).

Nineteen nuclear levels in ^{65}Ni of excitation energy up to 3.8 MeV were investigated by observing ^{64}Ni($\vec{d}$, p)^{65}Ni reactions and by observing ^{64}Ni($\vec{p}$, p)^{64}Ni elastic scattering near isobaric analog resonances in ^{65}Cu. Fifteen of the levels were investigated by both methods. Angular distributions of cross section and vector analyzing power were measured for the stripping reactions at lab angels between 20° and 135°. The incident deuteron energy was 10 MeV. The cross section and analyzing power for the proton elastic scattering were measured at two angles as a function of energy between 3 and 7 MeV. The ($\vec{d}$, p) measurements were compared with DWBA calculations, which qualitatively reproduce both the cross section and vector analyzing power measurements in all but two cases. The ($\vec{d}$, p) investigation yielded twelve definite and two tentative spin assignments for levels in ^{65}Ni. The proton elastic scattering measurements were fit by calculations that superimposed resonance terms onto an optical-model background. Nine definite and five tentative spin assignments were obtained for parent levels in ^{65}Ni. There is no disagreement between the values of l, j, and s obtained by the two methods. (RWR)

20096 NUCLEAR DATA SHEETS FOR A = 64. Auble, R. L. (Oak Ridge National Lab., TN). Nucl. Data Sheets; 12: No. 3, 305-342(Jul 1974).

Nuclear structure data available through December 1973 are compiled, and adopted level properties are presented. The present compilation represents an update of the previous work by H. Verheul (Nuclear Date B2-3-65, 1967). Where possible, the data are presented in comparative level diagrams, thereby eliminating many tabular listings. Also, where no additional data have appeared since the previous compilation, only the values adopted in the latter are presented here. These modifications have resulted in a substantial reduction in the size of the compilation, hopefully without unduly sacrificing its utility. (auth)

20097 EXPERIMENTAL SET-UP FOR THE MEASUREMENT OF PROMPT GAMMA RAYS RESULTING FROM INTERACTIONS OF 14.5 MeV NEUTRONS. Sztaricskai, T.; Barutcugil, E.; Scharbert, T.; Peto, G. (Kossuth Univ., Debrecen, Hungary). Acta Phys. Acad. Sci. Hung.; 36: No. 1, 25-32(1974).

An experimental apparatus was built and tested for the investigation of prompt gamma ray spectra produced by 14.5 MeV neutrons. To reduce the background the associated particle method was used. The time resolution of the 27 cm^3 trapezoidal coaxial Ge(Li) detector was 45 nsec, using an avalanche transistor as leading-edge-type time pick-off. The prompt gamma spectra of Fe and U were investigated in the 0.675 to 2.445 MeV range. (auth)

20098 ISOMERIC RATIOS IN ^{69}Zn, ^{80}Br, ^{81}Se, AND ^{165}Dy. Gill, D. R. Ottawa; Carleton Univ. (1972). National Library of Canada, Ottawa.

Thesis (Ph. D.).

Isomeric state production ratios in ^{69}Zn, ^{80}Br, ^{81}Se and ^{165}Dy were measured for the (n,γ) reaction as a function of neutron energy. A new gamma-ray cascade model for predicting these isomeric ratios was devised, and its results were compared with those of other models. This new model employed nuclear level densities generated numerically with a computer routine designed by Hillman and Grover. The gamma-ray transition probabilities were estimated from Moszkowski's formulae. The initial spin distribution of the compound nucleus was calculated using optical-model transmission coefficients. The measured isomeric ratios were found to be in a general sense in accord with the expectation that as the neutron energy increased the production of the high spin state would increase; however, the calculations made with the cascade model did not agree completely with these measurements. It was concluded that, despite its present shortcomings, the new cascade model (because it is parameter free) produced results which were more easily related conceptually to the forces and other properties of the nuclei that were studied. (Diss. Abstr. Int., B)

20099 STUDY OF THE GAMMA-RAY DECAY FROM EXCITED STATES OF ^{65}Zn. Ezell, R. L. Athens, GA; Univ. of Georgia (1973). 122p. University Microfilms Order No. 74-4791.

Thesis (Ph. D.).

The gamma-ray decay of 13 low-lying levels of ^{65}Zn was studied by means of the ^{63}Cu(p,nγ)^{65}Zn reaction. Thick natural copper targets were bombarded with a proton beam produced by Van de Graaff accelerator. The decay scheme was obtained from $\theta_\gamma = 90°$ yield curve measurements and from a neutron–gamma coincidence measurement. Angular distributions of gamma rays were measured for seven angles at $E_p = 3.5$ and 4.0 MeV. Gamma-ray energies, level energies, and branching ratios obtained are compared with recent measurements. Expected angular correlations for possible spin sequences were calculated by means of Hauser–Feshbach statistical reaction theory. The results, combined with other available evidence, established the J^π assignments for the following levels: 768.9 ± .1 keV ($5/2^-$), 864.8 ± .2 ($7/2^-$), 1047.5 ± .1 ($5/2^-$), 1252.9 ± .4 ($7/2^-$), 1263.9 ± .6 ($9/2^-$), and 1343.9 ± .1 ($5/2^-$). Previous assignments were confirmed for the levels 909.8 ± .1 keV ($3/2^-$) and 1369.5 ± .2 ($5/2^+$). Limiting J values were obtained for the levels 1577.1 ± .2 keV ($\leq 5/2$) and 1588.2 ± .4 ($\leq 7/2$). Gamma-ray multipole mixing ratios were extracted for 19 transitions between low-lying levels. Transition strengths were calculated where the level lifetimes were assumed to be in the range 10^{-12} to 10^{-13} s. A comparison of the experimental level scheme to theoretical predictions is presented. The results indicate more detailed calculations including core excitations or additional configuration mixing are needed. (Diss. Abstr. Int., B)

20100 ELASTIC AND INELASTIC SCATTERING OF ^{16}O FROM ^{58,60,62,64}Ni. West, L. Jr. Tallahassee; Florida State Univ. (1973). 143p. University Microfilms Order No. 74-6604.

Thesis (Ph. D.).

Measured elastic and inelastic scattering cross sections are reported for $^{16}O + {}^{58,60,62,64}Ni$ at bombarding energies ranging from 36 MeV to as high as 56 MeV in energy increments of 2 MeV. The optical model of nuclear scattering was used to parameterize the elastic scattering cross sections. The energy dependence of the real and imaginary well depth parameters is established, and ambiguities of the optical model parameters are examined. The inelastic (2+ first excited state) scattering cross sections were analyzed in terms of the distorted-wave Born approximation (DWBA). Computational methods are reviewed for DWBA calculations for heavy-ion inelastic scattering involving quadrupole excitation. Values of the nuclear deformation parameter which were deduced from DWBA calculations are found to be comparable to Coulomb deformation parameters as determined from known reduced quadrupole electromagnetic transition probability values. Folded potential calculations were performed for both the elastic and inelastic channels. The use of reported values of nucleon–^{16}O nuclear potential parameters and assumed values for Ni matter distribution parameters in the folded potential results in some improvement in the prediction of the data for both the elastic and inelastic scattering cross sections. (Diss. Abstr. Int., B)

20101 EXPERIMENTAL STUDY OF NEUTRON RADIATIVE CAPTURE IN ^{60}Ni AND Fe IN THE THERMAL TO LOW keV RANGE. Brown, P. H. Troy, NY; Rensselaer Polytechnic Inst. (1973). 259p. University Microfilms Order No. 74-12,779.

Thesis (Ph. D.).

The spectrum of γ rays given off following radiative neutron capture in ^{60}Ni and Fe was studied as a function of neutron energy. The RPI Linac acted as the neutron source, and the neutron energy was determined by the time-of-flight method (with a resolution of 8 ns/m) by using a lithium-drifted germanium (Ge(Li)) detector. The γ-ray resolution obtained with the Ge(Li) detector was 12 keV full-width at half-maximum (fwhm) for an 8-MeV γ ray and 4 keV FWHM for a 1-MeV γ ray. The intensities of prominent γ rays in the ^{60}Ni and Fe capture spectrum were measured as a function of neutron energy from thermal to low-keV neutron energies. In addition, the partial capture cross sections for these prominent γ rays were measured in the low-eV neutron energy range. The results, which show a dominance of the spectrum by only a few high-energy γ rays, are discussed in terms of the experimental observables due to compound-nucleus (statistical) capture and single-particle (nonstatistical) capture. (Diss. Abstr. Int., B)

20102 DIFFERENTIAL ELASTIC SCATTERING CROSS SECTIONS OF keV NEUTRONS FROM IRON AND NICKEL. Zuhr, R. A. Troy, NY; Rensselaer Polytechnic Inst. (1974). 184p. University Microfilms Order No. 74-12,807.

Thesis (Ph. D.).

Differential elastic scattering cross sections of neutrons from natural iron and nickel samples were measured in the energy region from 5 to 650 keV. The experiment used the pulsed source of photoneutrons provided by the R. P. I. linear electron accelerator, with neutron energies being determined by time-of-flight spectroscopy. The measurements were made at six angles ranging from 30 to 150 degrees, and the differential cross sections were determined relative to the known cross sections of a lead standard sample. The principal angular distribution results are presented in terms of the Legendre Polynomial expansion coefficients as functions of energy. Two sets of coefficients corresponding to averaged values over 20 and 50 keV are given. Comparisons are made with the available data on total and differential scattering cross sections. The data are consistent with the interpretation that s-wave scattering is dominant throughout the region of measurement, while p-wave scattering becomes evident above 250 keV. d-wave scattering, which is essentially zero below 400 keV, is comparable to the p-strength above this energy. The gross features of the angular distribution coefficients are characterized by resonant structure with widths on the order of 100 keV, which is much narrower than the width of the strength function as given by the imaginary optical-model potential. (Diss. Abstr. Int., B)

20103 STUDY OF CHARGED PARTICLES EMITTED FROM ^{117}Te COMPOUND NUCLEI. I. Argon-Induced Reactions. Galin, J.; Gatty, B.; Guerreau, D.; Rousset, C.; Schlotthauer-Voos, U. C.; Tarrago, X. (Institut de Physique Nucleaire, Orsay, France). Phys. Rev., C; 9: No. 3, 1113-1125(Mar 1974).

The compound nucleus ^{117}Te was formed with $^{40}Ar + {}^{77}Se$ at 71- and 107-MeV excitation energies; the maximum relative angular momenta in the entrance channels are about 70$\hbar$ and 110$\hbar$. The deexcitation by protons, deuterons, tritons, α particles, and lithium was studied, measuring absolute cross sections, energy spectra, and angular distributions. The experimental results, especially the strong anisotropies of the α-particle angular distributions and the dependence of the average energy on the emission angle, are discussed in terms of the statistical theory and the influence of very high angular momentum on the evaporation mechanism. The angular distributions of the elastic scattering have been measured simultaneously and are described by a strongly absorbing optical potential. (auth)

20104 GAMMA PRODUCTION CROSS SECTIONS FROM 14-MeV NEUTRON BOMBARDMENT OF ^{89}Y. Dietrich, F. S.; Gregory, M. C.; Anderson, J. D. (Lawrence Livermore Lab., CA). Phys. Rev., C; 9: No. 3, 973-980(Mar 1974).

The γ decays of levels in ^{88}Y and ^{89}Y have been observed with a Ge(Li) spectrometer following 14.1-MeV neutron bombardment of natural yttrium metal. Prompt and delayed (>50 nsec) radiations were separated by pulsing the neutron source. Following the reaction $^{89}Y(n,2n)^{88}Y$, delayed γ rays of 442 and 232 keV are ascribed to the decay sequence 8^+ (674 keV) $\rightarrow 5^-$ (232) $\rightarrow 4^-$ (0) and a 393-keV γ ray to the transition 1^+ (393) $\rightarrow 4^-$ (0). A delayed 909-keV radiation corresponds to the decay of the first excited state of ^{89}Y. Cross sections were determined with an uncertainty of ±11% for the delayed radiations and ±30% for the remainder. A statistical-model calculation for the $^{89}Y(n,2n)^{88}Y$ reaction reproduces the observed cross sections only if the γ branching ratios in ^{88}Y are taken from experiment, and in particular, the $(g_9)^2$ multiplet is included. (auth)

20105 STATES IN ^{85}Kr FROM THE $^{84}Kr(d,p)$ REACTION. Browne, C. P.; Olsen, D. K.; Chao, J.; Riley, P. J. (Univ. of Texas, Austin). Phys. Rev., C; 9: No. 5, 1831-1838(May 1974).

Thirty states in ^{85}Kr were investigated via the $^{84}Kr(d,p)^{85}Kr$ reaction by using 11.0 MeV deuterons. At least 22 of these states have not been previously reported. Angular distributions were measured from 20 to 160° for transitions to 25 of these states, and were fitted with zero-range distorted-wave Born-approximation calculations. Excitation energies, l values, spectroscopic factors, and the implied values of J^π are given. Comparisons are made with states of other nuclei having both one neutron less and one neutron more than the N = 50 shell closure. (9 figures, 2 tables) (auth)

20106 IN-BEAM MEASUREMENT OF E0 MATRIX ELEMENT IN ^{72}Se AND ^{72}Ge. Draper, J. E.; King, N. S. P.; Wyckoff, W. G. (Univ. of California, Davis). Phys. Rev., C; 9: No. 3, 948-952 (Mar 1974).

A 0^+ state in ^{72}Se at 936 keV has been identified through in-beam measurements with $^{70}Ge(\alpha,2n)^{72}Se$. The beam-related time distribution of conversion electrons from the 936-keV E0 transition yields a half-life of 19.3 ± 0.4 ns. With a ^{72}Ge target and an α-beam sweeper the half-life of the 690-keV E0 transition in ^{72}Ge was 404 ± 45 ns. For both transitions identification of the emitting nucleus was obtained from the energy separation of the K and L electrons. The K/L intensity ratio was intermediate between the theoretical results of Hager and Seltzer and those of Church and Weneser. The reduced E0 nuclear matrix elements are $\rho = (0.304 \pm 0.003)(1 - 5.01 \times 10^{-3} f)$ and $\rho = 0.095 \pm 0.005$ for ^{72}Se and ^{72}Ge, respectively, which are 0.77 (for $f \lesssim 40$) and 0.24, respectively, of Wilkinson's suggested single-particle unit for E0 matrix elements. The f is the $0' \rightarrow 2$ enhancement. (auth)

20107 STUDY OF CHARGED PARTICLES EMITTED FROM ^{117}Te COMPOUND NUCLEI. II. Comparison Between $^{40}Ar + {}^{77}Se$ and $^{14}N + {}^{103}Rh$ Reactions and Determination of Critical Angular Momenta. Galin, J.; Gatty, B.; Guerreau, D.; Rousset, C.; Schlotthauer-Voos, U. C.; Tarrago, X. (Institut de Physique Nucleaires, Orsay, France). Phys. Rev., C; 9: No. 3, 1126-1137 (Mar 1974).

The compound nucleus ^{117}Te was formed with $^{14}N + {}^{103}Rh$ at 71- and 107-MeV excitation energies. The deexcitation by protons, deuterons, tritons, and α particles was studied and compared to the deexcitation of the same compound nucleus ^{117}Te issued from $^{40}Ar + {}^{77}Se$ at the same excitation energies. The influence of angular momentum on the evaporation mechanism (angular distributions and cross sections of charged particles) have allowed to determine different values of critical angular momenta limiting compound-nucleus formation. These values are discussed with respect to different models. (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 18170, 19940, 20074, 20086, 20098, 20107, 20126, 20138, 20212, 20224, and 20242.

20108 (COO-2184-6, pp 4-9) STUDY OF SHORT-LIVED ISOMERS AT THE LOS ALAMOS TANDEM ACCELERATOR. Naumann, R. A.; Casella, V. R.; Knight, J. D. (Los Alamos Scientific Lab., NM). 26 Jun 1974.

In nuclear chemistry project.

20109 (INS-J-146) NEW ASPECTS OF THE QUASI-γ BAND. Sakai, M. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). 19 Apr 1974. 27p. (CONF-740228-1). Dep. NTIS (US Sales Only) $4.50.

From symposium on collective motion in medium nuclei; Tokyo, Japan (14 Feb 1974).

The quasi-γ band up to the 7^+ member newly found in ^{128}Xe gives a deep insight in the relationship between the phonon model and the rotational model. The B(E2) ratios of interband transitions, energy spacing of band members, and energy relation between the quasi-γ and quasi-ground bands are studied by use of known data in the literature together with the present data. It is revealed that the nuclear properties of the quasi-γ band are in many aspects common to those of the γ band in the deformed region. They are also discussed in connection with those of the second yrast members of phonon levels. (10 figures, 5 tables) (auth)

20110 (JINR-P3-7885) ANALYSIS OF SECONDARY GAMMA RAYS FOLLOWING RESONANCE NEUTRON CAPTURE IN ^{147}Sm. Aldea, L.; Becvar, F.; Huynh Thuong Hiep; Pospisil, S.; Telezhnikov, S. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 20p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Populations of low lying nuclear levels are treated in a frame of the statistical model. Calculations are presented for the case of the resonance neutron capture in ^{147}Sm nuclei, and a comparison with the experimental data is given. (auth)

20111 (KHFTI-73-9, pp 89-92) FISSION PROCESS OF NUCLEI UNDER THE ACTION OF HIGH-ENERGY PARTICLES AND NUCLEI. Barashenkov, V. S. (Joint Inst. for Nuclear Research, Dubna, USSR); Il'inov, A. S.; Toneev, V. D.; Gudima, K. K.; Zheregi, F. G. 1973. (In Russian).

A method for the calculation of the fission barrier B_f is proposed. It consists in the extraction from experimental values the phenomenological "nonregular parts" of the barrier that are dependent on the shell corrections, the residual interaction, and other effects of nuclear structure. The "continuous parts" of B_f^0 can be derived by a simple analytical dependence. B^0 is approximated well by functions dependent only on the ratio Z^2/A. The results of the calculation of B_f were reported for ^{149}Eu, ^{185}Ir, ^{227}Ra, ^{235,239}U, and ^{251,254,259}No. The experimental data and the results of calculations by other models were reported for comparison. (tr-auth)

20112 (NP-20057) SURVEY OF SHORT-LIVED FISSION PRODUCTS OBTAINED USING THE ISOTOPE-SEPARATOR-ON-LINE FACILITY AT STUDSVIK. Grapengiesser, B.; Lund, E.; Rudstam, G. (Forskningsraadens Lab., Studsvik (Sweden)). 1973. 46p. (LF-47). Dep. NTIS (US Sales Only) $5.50.

Using the OSIRIS facility (isotope separator on-line facility), mass-separated samples containing isotopes of the elements from zinc to zirconium (selenium, yttrium and zirconium as decay products only) and from silver to cerium (lanthanum and cerium as decay products only) have been prepared, and their decay has been followed by means of $4\pi\beta$-counting or delayed neutron-counting. Half-life data in the range from about 1 second to about 10 minutes have been determined for 85 fission products. In addition, results obtained at OSIRIS using other techniques are surveyed. (auth)

20113 (RCN-203, pp 194-218) SYSTEMATICS OF TOTAL RADIATIVE WIDTHS OF NEUTRON RESONANCES. Weigmann, H.; Rohr, G. (Central Bureau for Nuclear Measurements, Geel, Belg.). Dec 1973.

From nuclear physics with thermal and resonance energy neutrons; Petten, Netherlands (22 May 1973).

An attempt is made to fit experimental radiative widths of neutron resonances of nuclei in the mass number range $40 \leq A \leq 247$ by a semiempirical expression. This expression contains, besides the usual statistical-model term, a second term which takes into account valency nucleon contributions. Shell effects are taken into account through a simple representation of their influence on compound-nucleus level densities. Throughout the analysis an attempt is made to limit the number of free parameters and to relate the parametrization as closely as possible to physical principles. Comparison is made with earlier studies of similar type. (4 tables, 109 references) (auth)

20114 (RCN-203, pp 219-225) ANALYSIS OF NEUTRON RESONANCES IN ^{143}Nd. Ceulemans, H. (SCK/CEN, Mol, Belg.). Dec 1973.

From nuclear physics with thermal and resonance energy neutrons; Petten, Netherlands (22 May 1973).

A shape analysis of the transmission spectra was performed for each of four sample thicknesses separately. The resonance parameters obtained are tabulated and compared with results from the literature. The sum of the strength function S_0 (3^-) and S_0 (4^-) for ^{143}Nd is given for the energy ranges 0 to 840, 840 to 1680, and 0 to 2128 eV. (2 tables) (RWR)

20115 (RCN-203, pp 226-241) NEED OF NUCLEAR LEVEL SCHEMES FOR CALCULATED CROSS SECTIONS OF FISSION PRODUCT NUCLEI. Gruppelaar, H. (Reactor Centrum Nederland, Petten). Dec 1973.

From nuclear physics with thermal and resonance energy neutrons; Petten, Netherlands (22 May 1973).

For many fission product nuclei no measurements of fast-neutron cross sections are available; for other fission product nuclei only a few measured points are known. Calculated cross sections are needed, therefore, to provide a set of data with adjustable parameters. Adjustments to cross section data can be applied by using experimental data of differential measurements from accelerators or by using results of integral experiments like the reactivity worths measured in the Dutch STEK reactor. In the energy range between 0.1 MeV and 3 MeV, which is important for fast breeder reactors, a good knowledge of excitation energies, spins, and parities of levels in the target nucleus is necessary for the calculation of both the neutron inelastic scattering cross section and the neutron absorption cross section. The need of level scheme information and the desirability of a compilation and/or evaluation of these data for practical calculations of fission product neutron cross sections are discussed. (5 figures, 3 tables) (auth)

20116 (RCN-203, pp 254-268) SPINS OF ^{147}Sm AND ^{149}Sm NEUTRON RESONANCES. Karzhavina, E. N.; Kim Sek Su; Popov, A. B. (Joint Inst. for Nuclear Research, Dubna, USSR). Dec 1973. (In Russian).

From nuclear physics with thermal and resonance energy neutrons; Petten, Netherlands (22 May 1973).

Spins of ^{147}Sm and ^{149}Sm neutron resonances were measured in the region up to 400 eV by the method of γ-quantum multiplicity by using the neutron spectrometer of the Laboratory of Neutron Physics. Spins of 50 resonances of ^{147}Sm and 70 resonances of ^{149}Sm were determined. It is shown that the strength functions of ^{147}Sm and ^{149}Sm are independent of the spin, and the level density dependence on the spin agrees well with theoretical predictions. (10 figures, 2 tables) (auth)

20117 (SUNI-28, pp 7-9) LEVEL STRUCTURE OF ^{115}In FROM (n, n'γ) MEASUREMENTS. van Heerden, I. J.; McMurray, W. R. (Southern Universities Nuclear Inst., Faure, South Africa). 1973.

20118 (n,^{3}He) AND (n,t) REACTION CROSS-SECTIONS AT 14 MeV. Diksic, M.; Strohal, P.; Slaus, I. (Institut Rudjer Boskovic, Zagreb). J. Inorg. Nucl. Chem.; 36: No. 3, 477-485 (Mar 1974).

The (n,^{3}He) reaction cross section has been measured at E_n = 14.6 MeV for ^{31}P, ^{41}K, ^{55}Mn, ^{59}Co, ^{63}Cu, ^{71}Ga, ^{75}As, ^{96}Zr, ^{93}Nb, ^{103}Rh, ^{109}Ag, ^{115}In, ^{130}Te, and ^{187}Re, and the following values have been obtained: 222 ± 100, 848 ± 320, 800 ± 320, 62 ± 30, 113 ± 40, 66 ± 20, 578 ± 200, 136 ± 50, 17.9 ± 9.0, 16 ± 7, 23 ± 10, 33 ± 15, 15 ± 8, and 4 ± 3 μ barn. The (n,t) reaction cross-section has also been measured at E_n = 14.6 MeV for ^{32}S, ^{40}Ca, ^{54}Fe, ^{64}Zn, and ^{89}Y; and the following values have been obtained: 154 ± 70, 310 ± 180, 351 ± 150, 33.7 ± 10, and 15.4 ± 10 μ barn. In previous measurements, mainly the upper limits were obtained. The (n,^{3}He) reaction cross-sections show a general tendency to decrease with increasing A. The obtained data have been compared with the statistical model predictions. (auth)

20119 NUCLEAR DATA SHEETS FOR A = 140. Peker, L. K.; Sigalov, V. M.; Kharitonov, Yu. I. (Leningrad Nuclear Physics Inst.). Nucl. Data Sheets; 12: No. 3, 343-396(Jul 1974).

Nuclear structure data for mass-140 nuclei are compiled, and adopted level and gamma-ray properties are presented. The adopted values are based on all data received before August 1973. (auth)

20120 DELAYED NEUTRON EMISSION FROM MASS-SEPARATED FISSION PRODUCTS. Norman, J. H. Ames, IA; Iowa State Univ. (1973). 130p. University Microfilms Order No. 74-9145.

Thesis (Ph. D.).

Delayed neutron characteristics of six fission product nuclides were determined by using a mass separator operated on-line with a nuclear reactor. Beta-decay half-lives were measured by using neutron multiscaling techniques for the precursors ^{95}Br, ^{99}Br, ^{93}Kr, ^{93}Rb, ^{137}I, and ^{139}I. The observed half-lives were 16.52 ± .34, 4.32 ± .05, 1.296 ± .022, 5.926 ± .044, 24.42 ± .08, and 6.40 ± .17 seconds, respectively. Energy spectra were measured for delayed neutrons emitted in the beta-decays of ^{17}N, ^{137}I, ^{93}Kr, and ^{93}Rb. The spectra of neutron emission in the mass-93 parent-daughter decay chain were observed by using a moving tape

collector to effect isobaric separation. Two different types of ^{3}He-filled neutron spectrometer were used to determine the spectra, a proportional counter with risetime discrimination electronics and a high-resolution ionization chamber. The measured delayed neutron spectra obtained by using both detector types are presented; and the results, compared, where possible, with other reported measurements. (Diss. Abstr. Int., B)

20121 STUDY OF THE VECTOR ANALYZING POWER AND DIFFERENTIAL CROSS SECTION FOR THE REACTIONS ^{118}Sn(d VECTOR, t)^{117}Sn AND ^{98}Mo(d VECTOR, t)^{97}Mo. Vigdor, S. E. Madison, WI; University of Wisconsin (1973). 205p. University Microfilms Order No. 73-30,352.

Thesis (Ph. D.).

A 12.0-MeV vector-polarized deuteron beam was used to initiate ($\vec{d}$, t) neutron-pickup reactions on ^{118}Sn and ^{98}Mo. The vector analyzing power $iT_{11}(\theta)$ and differential cross section $\sigma(\theta)$ were measured as a function of reaction angle for ($\vec{d}$, t) transitions to six states of ^{117}Sn(E_x = 0.0, 0.16, 0.31, 0.71, 1.02, and 1.18 MeV), to eight states of ^{97}Mo (E_x = 0.0, 0.68, 0.72, 0.89, 1.12, 1.28, 2.39, and 2.52 MeV), and for the elastic scattering ^{118}Sn($\vec{d}$,d)^{118}Sn and ^{98}Mo($\vec{d}$,d)^{98}Mo. Deuteron optical model potentials were obtained from analysis of the elastic scattering measurements, and were used in a distorted-wave Born approximation (DWBA) analysis of the ($\vec{d}$, t) results. The vector analyzing power for the ($\vec{d}$, t) transitions with orbital angular momentum transfer l_n = 0 is found to be sensitive to the deuteron–nucleus, but not to the triton–nucleus, spin–orbit interaction. An observed correlation for the l_n = 0 transitions between iT_{11} (θ) and the slope of the cross section angular distribution reflects properties of both the deuteron spin–orbit potential and the (d, t) reaction mechanism. For the (d, t) transitions with $0 < l_n \leq 5$, the vector analyzing power is strongly dependent on the value of the total angular momentum transfer $j_n = l_n + \frac{1}{2}$ being in most cases preferentially opposite in sign to $(j_n - l_n)$. Spins determined in the present work from comparison of the measurements and DWBA predictions for $iT_{11}(\theta)$ confirm previous assignments to states in ^{117}Sn, but augment and amend the existing body of spectroscopic knowledge of ^{97}Mo. The observed sign preference in iT_{11} (θ) is reproduced by DWBA calculations employing only Coulomb distortions. (RWR)

20122 INVESTIGATIONS OF QUASI-ROTATIONAL BAND STRUCTURES IN THE Pd NUCLEI. Smith, G. J. Lafayette, IN; Purdue University (1973). 136p. University Microfilms Order No. 74-4976.

Thesis (Ph. D.).

Quasi-rotational band structure was observed in the Pd nuclei ^{99}Pd–^{105}Pd. States in the Pd nuclei were populated via (heavy ion, xn) reactions with projectiles of α particles, ^{12}C, ^{13}C, and ^{16}O. Three experiments for each nucleus were performed: excitation function measurement, γ–γ coincidence measurement and directional distribution measurement. The even–even Pd nuclei exhibit a quasi-rotational ground-state band, populated up to I = 14. In addition $^{102,\ 104}$Pd exhibit a second band built upon an excited state. The odd-A Pd nuclei exhibit quasi-rotational bands upon single-particle states. ^{101}Pd exhibits three such bands, while the other odd-A nuclei exhibit only two bands. The odd-A bands suggest a picture of a particle coupled as a "spectator" to a rotational core. The band states are then reflections of the rotational states of the core. A relationship was observed between the type of reaction used and the population of an odd-A band. This suggests that there are critical energy and angular momentum values which must be exceeded before a quasi-rotational band built upon a particle state can be populated. No such "threshold" effect was observed for the even-A Pd nuclei. (Diss. Abstr. Int., B)

20123 DECAY OF ^{106m}Ag. Inoue, H. (Osaka Univ.). J. Phys. Soc. Jap.; 35: No. 4, 957-966(Oct 1973).

Gamma rays and internal conversion electrons following the decay of 8.3 d ^{106m}Ag were studied with Ge(Li) spectrometers and an orange type beta-ray spectrometer. Energies and intensities of some low energy gamma rays were measured precisely. Conversion coefficients for weak and high energy transitions were determined to estimate the multipolarities of these transitions. New gamma rays of 69, 70, 80, 83, 178, 434, 522, 950, 1051, 1077, 1168, 1178, 1349, 1419, 1909 and 2077 keV were observed. New levels are proposed from some of these gamma rays. Two three-phonon states are suggested on the basis of the observed gamma ray branching ratios to the low lying two-phonon states. (auth)

20124 INVESTIGATION OF THE EXCITED STATES OF THE NUCLEI ^{105,106,108}Pd AND ^{161}Tb. Begzhanov, R. B.; Kobilov, O. Sh.; Radzhapov, P. S.; Sabirov, Kh. S.; Salimov, S. Kh.; Sulaimanov, M. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 1, 35-37(1974). (In Russian).

The energy levels of ^{105}Pd, ^{108}Pd, and ^{161}Tb and the angular correlations of the γ radiation of ^{106}Pd, ^{108}Pd, and ^{161}Tb were studied. The individual γ spectra and γ–γ coincidence spectra were measured on a Ge(Li) detector and with NaI(Tl) crystals. 18 γ transitions were identified in ^{105}Pd and 19 in ^{161}Tb. The existence of the 388-keV γ transition in ^{108}Pd was shown and its intensity and multipolarity determined. The results of the measurements of the angular correlations are tabulated. (JSR)

20125 ENERGY LEVELS OF ^{132}Xe, ^{133}Xe, ^{135}Xe, AND ^{140}Ce: A GAMMA RAY STUDY. Saxena, R. N. Waterloo, Ont.; Univ. of Waterloo (1973). National Library of Canada, Ottawa.

Thesis (Ph. D.).

The energies and relative intensities of the γ-rays following the decay of ^{133}I and ^{135}I were measured by using a Ge-(Li) detector. Gamma–gamma coincidences were measured by using a Ge(Li)–Ge(Li) detector system and an on-line IBM 360-44 computer. The decay of ^{133}I was found to involve 29 γ rays and to populate 13 excited states in ^{133}Xe. A comparison of positive-parity states found in this study was made with those predicted by the intermediate-coupling model. Fifty-seven γ rays were identified in the β decay of 6.7-h ^{135}I. A level scheme of ^{135}Xe incorporating 24 excited states was proposed based on the coincidence data and relative intensities of the observed γ rays. Tentative spin and parity assignments were made. Directional correlations of coincident gamma transitions in ^{132}Xe and ^{140}Ce were measured by using a Ge(Li)–NaI(Tl) spectrometer. γ–γ coincidences were accumulated at 14 different angular positions. Multipole mixing ratios, δ, were obtained from the correlation data. Predicted electron-conversion coefficients were compared with the experimentally measured values, and the spins and parities of the levels were assigned. The results are discussed in terms of collective vibrational model. γ–γ directional correlations of cascades in ^{140}Ce were measured and multipole mixing ratios were obtained. The predicted electron-conversion coefficients were compared with the experimentally observed values. Spin and parity assignments were made for the levels. Positive-parity states were compared with those predicted from the shell-model calculations. (RWR)

20126 EXPERIMENTAL STUDY OF REACTION MECHANISMS IN INELASTIC SCATTERING OF 61 MeV PROTONS. Owais, M. Athens, GA; Univ. of Georgia (1973). 116p. University Microfilms Order No. 74-4849.

Thesis (Ph. D.).

Differential cross sections were measured for the excitation of low-lying states in ^{92}Zr and ^{207}Pb by 61.2-MeV protons in broad-range spectrograph. Microscopic-model calculations provide good fits to the shapes of measured cross sections for the excitation of the neutron states at 0.93 and 1.49 MeV in ^{92}Zr and for the excitation of the "neutron-hole" states in ^{207}Pb at 0.568, 0.894, 1.63, and 2.33 MeV. The S = 0 core polarization contributions are important for these neutron transitions, but the S = 0 valence contributions are much more important than for proton transitions in similar nuclei. The core coupling parameter, A_2, for the transition to the first 2^+ level in ^{92}Zr is close to the value of A_2 for the first 2^+ level in ^{90}Zr and the polarization charges (e_{eff}–e_i) for both transitions are in agreement with values from other experiments; hence, there is little evidence here for isospin dependence of core polarization. There is very little energy dependence of this A_2 for ^{92}Zr. The core coupling parameter A_4 and the polarization charge (e_{eff}–e_i) for the transition to the first 4^+ level in ^{92}Zr are much smaller than the values for the first 4^+ level in ^{90}Zr; this finding suggests a much stronger isospin dependence of core polarization in the (p,p') reaction for L = 4 transitions than for L = 2 transitions. There is an apparent strong energy dependence of this A_4 in ^{92}Zr in the (p,p') reaction. The core coupling parameters, A_L, and effective charges, e_{eff}, for these L = 2, L = 4, and L = 7 "neutron-hole" transitions in ^{207}Pb suggest a strong dependence of the core polarization mechanism on the angular momentum transferred in the (p,p') reaction. Comparisons with other (p,p') experiments suggest a strong energy dependence of the core polarization mechanism for these transitions. This ^{92}Zr experiment suggests the assignment of 2^+ for the 1.85-MeV state, 2^+ for the 2.07-MeV state if excited by a multiple-step mechanism, and a new assignment of 5^- for the state at 2.48 MeV. This experiment yields the value of β_3 = 0.10 for the excitation of the doublet at 2.61 MeV in ^{207}Pb. (Diss. Abstr. Int., B)

20127 NUCLEAR REACTION STUDIES. 1. Low Energy Neutron Spectra from (p,n) Reactions. 2. Inelastic Proton Scattering Angular Distributions. 3. Gamma Ray Multiplicity. Degnan, J. H. Jr. Pittsburgh; Univ. of Pittsburgh (1973). 115p. University Microfilms Order No. 74-8713.

Thesis (Ph. D.).

Low-energy neutron spectra from (p,n) reactions were determined by observing protons from (p,np) reactions. This was done for ^{90}Zr and ^{112}Sn (p,n) reactions. When the shapes of the neutron spectra are analyzed by statistical theory, it is found that the cross section for the inverse reaction exhibits a maximum in

energy dependence near target mass A = 90. Inelastic proton scattering angular distributions were determined by a new technique which greatly suppresses the background from elastic scattering, the technique is gating the proton energy signal with a proton–gamma ray coincidence requirement. This distorts the (already known) energy shapes of the spectra, but not the angular distributions (at least for higher residual nucleus excitation energies). This was done for ^{112}Sn, ^{119}Sn, and ^{122}Sn (p,p′) reactions with 17, 17, and 15 MeV, respectively. "Ungated" angular distributions were also obtained for ^{119}Sn (p,p′). The "gated" and "ungated" angular distributions agreed well for those angles ($\theta > 60°$) for which the ungated angular distributions are expected to be reliable. The angular distributions are isotropic for higher excitation energies for ^{112}Sn (p,p′) and forward peaked (to the extent of about a factor of 1.5) for ^{119}Sn and ^{122}Sn (p,p′). The average number of γ rays emitted in the decay of residual nuclei, N_γ, was also determined. This quantity was measured for 56 reactions as a function of E^* for E^* below the particle emission threshold. N_γ was observed to be generally between 1 and 5 for E^* between 3 and 10 MeV for the (p,p′), (d,p), (d,α), (p,α), and (α,α') reactions investigated, and somewhat higher for (α,p) reactions. N_γ increases with E^*, and is somewhat larger for higher angular momentum transfer reactions. N_γ is considerably larger for (α,p) reactions than for (d,p) reactions. The dependence of N_γ on the average excess angular momentum of the residual nuclei was investigated. (RWR)

20128 STUDY OF THE ^{104}Ru(d,p)^{105}Ru AND ^{110}Pd(d,p)^{111}Pd REACTIONS. Mlekodaj, R. L. Tallahassee; Florida State Univ. (1973). 209p. University Microfilms Order No. 74-8405.

Thesis (Ph. D.).

The reactions ^{104}Ru(d,p)^{105}Ru and ^{110}Pd(d,p)^{111}Pd were studied, and excitation energies, l values, cross sections, and spectroscopic factors were extracted. The resulting spectra of ^{111}Pd and ^{105}Ru were compared with various nuclear models with a view of finding the model that is the best zeroth-order approximation for these transitional nuclei. The models used for comparison are the shell model, a particle–phonon coupling model, the simple Nilsson model, and the Nilsson model including Coriolis effects. (Diss. Abstr. Int., B)

20129 PROPERTIES OF LEVELS IN THE ^{105}Pd NUCLEUS. Begzhanov, R. B.; Gladyshev, D. A.; Azimov, K. Sh.; Narzikulov, M. N. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 1, 40-43(1974). (In Russian).

By means of a fast-slow coincidence counter the lifetimes of excited levels at 280, 306, 319, 344 and 644 keV were measured in the ^{105}Pd nucleus. On the basis of these results, experimental values were calculated for the probabilities of numerous gamma transitions in this nucleus. (SJR)

20130 TABLES OF ANGULAR-DISTRIBUTION COEFFICIENTS FOR GAMMA RAYS OF MIXED MULTIPOLARITIES EMITTED BY ALIGNED NUCLEI. Der Mateosian, E.; Sunyar, A. W. (Brookhaven National Lab., Upton, NY). At. Data Nucl. Data Tables; 13: No. 5, 407-462(May 1974).

Values of angular-distribution coefficients were calculated for gamma rays of mixed multipolarities emitted by aligned nuclei in transitions between states of both integral spins and half-integral spins. (auth)

20131 TABLES OF ATTENTUATION COEFFICIENTS FOR ANGULAR DISTRIBUTION OF GAMMA RAYS FROM PARTIALLY ALIGNED NUCLEI. Der Mateosian, E.; Sunyar, A. W. (Brookhaven National Lab., Upton, NY). At. Data Nucl. Data Tables; 13: No. 5, 391-406(May 1974).

A set of attenuation coefficients was calculated to be used in the interpretation of angular distributions of gamma radiation from partially aligned nuclei. To facilitate the use of these tables, the angular-distribution functions appropriate for totally aligned nuclei, as calculated by Yamazaki, were extended to higher spins. (auth)

20132 EFFECTS OF THE DEUTERON D-STATE IN SUB-COULOMB ELASTIC SCATTERING AND (d,p) REACTIONS. Knutson, L. D. Madison, WI; Univ. of Wisconsin (1973). 279p. University Microfilms Order No. 74-9004.

Thesis (Ph. D.).

Angular distributions of the differential cross section and the four analyzing powers were measured for deuteron elastic scattering and for (d,p) reactions. The experiments were carried out with a polarized deuteron beam incident on ^{208}Pb at 9 MeV and on ^{90}Zr at 5.5 MeV. The elastic scattering measurements were analyzed by using the deuteron optical model. The measured tensor analyzing powers can not be reproduced by an optical model potential which contains only central and spin–orbit terms. The spin–orbit and tensor terms in the deuteron–nucleus potential were calculated from the folding model. The central terms in the optical model potential were treated phenomenologically. The resulting potentials successfully reproduced the measured cross sections and analyzing powers for both target nuclei. The measured cross sections and analyzing powers for the (d,p) reactions were compared with the predictions of the distorted-wave Born approximation (DWBA). For the ^{208}Pb(d,p)^{209}Pb reaction, the tensor analyzing powers predicted by DWBA are essentially zero if the D state is not included. If one includes the deuteron D state in the calculation, the DWBA results are in good agreement with the measurements. For the reaction ^{90}Zr(d,p)^{91}Zr the agreement of the DWBA calculations with the measurements is not so accurate as for the ^{208}Pb(d,p)^{209}Pb reaction. The effects of the deuteron D state on the ^{90}Zr(d,p)^{91}Zr reaction are discussed. A classical model for sub-Coulomb (d,p) reactions is described. (RWR)

20133 NEUTRON AND DEUTERON TRANSFER REACTIONS IN THE A = 100 MASS REGION. Schoonover, J. L. Montreal, Quebec; McGill Univ., Montreal (1973). National Library of Canada, Ottawa.

Thesis (Ph. D.).

The ^{96,100}Mo(^{3}He,α)^{95,99}Mo, ^{94,97,98}Mo(d,α)^{93,95,96}Nb and ^{93}Nb(d,α)^{91}Zr reactions were investigated with an 18-MeV ^{3}He and a 12-MeV deuteron beam from the Universite de Montreal tandem accelerator. The energies and angular distributions of the α-particle groups emitted in the experiments were measured by using silicon detectors in conjunction with a large scattering chamber. Numerous states in the residual nuclei were identified, some of them previously not observed. The DWBA method was employed to assign l transfers to the angular distributions in the (^{3}He,α) data; some new spin and parity assignments and spectroscopic factors were obtained. These latter quantities were found to be in good agreement with spectroscopic factors extracted in other experiments on the same nuclei. To existing data the present work adds the selectivity of the (^{3}He,α) reaction in populating states of higher J values with the result that spin and parity assignments are made less ambiguous. The (d,α) angular distributions were analyzed by using a two-step mechanism for the two-nucleon-transfer reaction. It was found that this process makes a significant contribution to the magnitude of the reaction cross section, and that the shapes of the angular distribution patterns are often best fit by those theoretical patterns associated with "parity-violating" l transfers, that is, those l transfers which are allowed in two-step, but not in one-step, processes. Some tentative spin and parity assignments were made on the basis of this new approach. (Diss. Abstr. Int., B)

20134 GROUND STATE HYPERFINE STRUCTURE OF ^{95}Mo AND ^{97}Mo. Buettgenbach, S.; Herschel, M.; Meisel, G.; Schroedl, E.; Witte, W. (Bonn Univ. (F. R. Germany). Inst. fuer Angewandte Physik); Childs, W. J. (Bonn Univ. (F. R. Germany). Inst. fuer Angewandte Physik; Argonne National Lab., Ill. (USA)). Z. Phys.; 266: No. 4, 271-274(Feb 1974).

1 fig.; 2 tabs.; 18 refs.

The hyperfine structure of the ground state $4d^5\ 5s\ ^7S_3$ of ^{95}Mo and ^{97}Mo was measured by the atomic beam magnetic resonance technique and the hyperfine interaction constants A, B, C, D were determined. With the known ratio of the nuclear g-factors for ^{95}Mo and ^{97}Mo a calculation of the hyperfine anomaly yields $_{95}\Delta_{97} = -0.01009(17)\%$. From the corrected B factors which differ considerably from the uncorrected ones because of the relatively large effects of second order hyperfine structure, the electric quadrupole moments may be evaluated by means of the calculated radial integrals. The results are: $Q(^{95}\text{Mo}) = -0.019(12)$ barns, $Q(^{97}\text{Mo}) = 0.102(39)$ barns. (auth)

20135 ELECTRIC MONOPOLE STRENGTH IN ^{100}Ru. Koike, M.; Kawakami, H.; Sakamoto, K. (Univ. of Tokyo). Phys. Rev., C; 9: No. 3, 1174-1176(Mar 1974).

The electric monopole transition from the 1130-keV (0^+) state of ^{100}Ru was found from internal-conversion-electron studies of the decay of ^{100}Pd. The observed branching ratio of the conversion-electron emission of the crossover E0 and cascade E2 transitions $J_{eK}(E0)/J_{eK}(E2)$ was 0.075. The electric monopole strength $\rho(E0)$ had an upper limit of 0.089. (1 figure, 2 tables) (auth)

20136 EXPONENTIAL DEPENDENCE OF THE NUCLEAR MOMENT OF INERTIA ON PAIRING CORRELATION AND THE PAIRING STRETCH MODEL FOR NUCLEAR ROTATION. Ma, C. W. (Indiana Univ., Bloomington); Rasmussen, J. O. Phys. Rev., C; 9: No. 3, 1083-1090(Mar 1974).

Nuclear moments of inertia calculated from the cranking model show the dependence on pairing correlation to be nearly exponential over most of the region of physical interest. Furthermore, the uncorrelated wave functions yield moments of inertia deviating in some cases considerably from rigid-body values. The exponential relation is applied to the calculations of rotational energies in a pairing stretch model. With two adjustable parameters the energy fits are quite good. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 20086, 20111, 20113, 20116, 20118, 20136, and 20224.

20137 (RCN-203, pp 57-68) ROTATIONAL STRUCTURE OF THE DOUBLY ODD DEFORMED ^{182}Ta NUCLEUS. Van den Cruyce, J. M.; Vandenput, G.; Jacobs, L. (Univ., Louvain, Belg.). Dec 1973.

From nuclear physics with thermal and resonance energy neutrons; Petten, Netherlands (22 May 1973).

The low-energy part of the gamma spectrum from thermal-neutron capture was studied by high-resolution and coincidence measurements, as well as by observing the conversion-electron spectrum. A level scheme resulting from these measurements is given and discussed. It contains 50 levels below 1 MeV, which can be grouped into 12 rotational bands. Although the situation for the lowest bands is quite clear and can be satisfactorily described by the unified model when the effect of rotation–particle coupling is taken into account, the interpretation of the high-lying states, especially those based on the $^5/_2^+$[402] proton orbital, remains questionable. (3 figures, 3 tables) (RWR)

20138 NEUTRON CROSS SECTIONS OF SAMARIUM-147 AND SAMARIUM-150. Eiland, H. M.; Weinstein, S.; Seemann, K. W. (Knolls Atomic Power Lab., Schenectady, NY). Nucl. Sci. Eng.; 54: No. 3, 286-299(Jul 1974).

The total neutron cross sections of samarium highly enriched in the ^{147}Sm and ^{150}Sm isotopes have been measured from 0.01 eV to 1.2 keV. Thermal-neutron cross sections and resonance parameters were extracted, and the S-wave strength functions and capture resonance integrals were calculated. Corrections for paramagnetic and small-angle scattering were applied to the thermal-neutron cross sections in order to obtain thermal absorption cross sections. The following results were obtained for ^{147}Sm and ^{150}Sm, respectively: strength function, S_0: $(4.3 \pm 1.3)10^{-4}$, $(3.3 \pm 1.1)10^{-4}$; resonance integral (b): 714 ± 50, 310 ± 15; σ_t (0.0253 eV), (b): 77 ± 6, 135 ± 8; σ_a (0.0253 eV), (b): 56 ± 7, 107 ± 9. (13 figures, 7 tables) (auth)

20139 STRUCTURE OF EVEN-A DEFORMED NUCLEI IN THE RARE EARTH REGION: A STUDY OF THE DECAY CHAIN 158-ERBIUM TO 158-DYSPROSIUM INCLUSIVE. Ruth, T. J. Worcester, MA; Clark Univ. (1973). 136p. University Microfilms Order No. 74-8452.

Thesis (Ph. D.).

The decay of 2.3-h ^{158}Er and ^{158m,} ^{158}Ho produced by (heavy ion, xn) reactions on isotopically enriched rare earth targets was studied by γ-ray singles and coincidence spectroscopy and Ge(Li) detectors. The conversion electron results of Harmatz and Handley (^{158}Ho) and Abdurzakov, et al., (^{158}Dy) were combined with the γ-ray results of the present study to calculate conversion coefficients and deduce multipolarities. Nearly 150 γ transitions were assigned to the A = 158 decay chain among levels in ^{158}Ho and ^{158}Dy. Levels in ^{158}Ho were confirmed at 67.3 keV (2^-), 118.0 keV (2^+), 139.3 keV (1^-), 182.7 keV (2^-), 315.9 keV (1^+), 378.1 keV (1^-), 406.8 keV (2^+), 425.5 keV (1^-), 454.2 keV (1^-), 478.7 keV, and 655.5 (1^-). New levels were assigned at 710.6 keV, 1070.7 keV, 1335.5 keV, 1340.8 keV, and 1597.4 keV. Levels with known spin were assigned a Nilsson configuration. The half-life for the β-decay of ^{158}Er was determined to be 2.27 ± 0.18h. The new level scheme for ^{158}Dy included a ground-state rotational band, a γ-vibration rotational band, a β-vibration band, a two-quasi-neutron rotational band, a K = 2 rotational band, four positive-parity states with spin 3 or 4, and negative-parity states. The results of ground-state, γ-vibration, and β-vibration rotational bands are compared with the results of reaction studies. The bands are also compared with the predictions of several phenomenological models. Trends in the rotational constant $\hbar^2/2I$ for the ground state and γ-vibrational bands are noted for the even-even nuclei of dysprosium. (RWR)

20140 LEVEL STRUCTURES IN EVEN OSMIUM NUCLEI FROM RADIOACTIVE DECAY AND IN-BEAM GAMMA-RAY SPECTROSCOPY. Hochel, R. C. Lafayette, IN; Purdue University (1973). 203p. University Microfilms Order No. 74-4977.

Thesis (Ph. D.).

A systematic investigation of the level structure of the transitional nuclei ^{184}Os, ^{186}Os, and ^{188}Os was performed by the combined techniques of radioactive decay and in-beam γ-ray spectroscopy. The first detailed study of the EC/β^+ decay of 3.1 h ^{184}Ir was carried out by using sources produced by the ^{186}Re (^{3}He, 4n) reaction. Measurements included γ-ray singles, β^+-ray endpoint, conversion coefficient, β^+–γ and detailed γ–γ coincidence determinations. An extensive ^{184}Os level scheme was constructed which includes well-developed ground-state, γ-vibrational, and $K^\pi = 3^-$ octupole bands. The Q value for the ^{184}Ir decay was determined to be 4.2 + 0.1 MeV. A particularly unusual feature of the ^{184}Ir decay is the strong direct population of the 4^+ and 6^+ members of the ^{184}Os ground state band with log-ft values indicative of allowed hindered or first forbidden transitions. It is concluded that the ^{184}Ir ground-state configuration has a spin of 5 and contains large admixtures of K = 0 or K = 1 character. It is proposed that the level ordering in ^{184}Ir and ^{186}Ir is largely determined by the properties of the [541] orbital stemming from the $j = 9/2$ spherical state. Investigations of the ^{184}Os, ^{186}Os and ^{188}Os levels by in-beam γ-ray spectroscopy were performed by means of (α, 2nγ) reactions. Enriched targets of ^{182}W, ^{184}W and ^{186}W were bombarded with 24 MeV α-particles. Level schemes accommodating all of the strong transitions observed in the in-beam measurements were constructed. In the (α, 2n) reactions into ^{186}Os and ^{188}Os, 5^- levels at 1629 and 1668 keV play a major role in the de-excitation cascades. $K^\pi = 3^-$ band-heads are tentatively identified at 1480 and 1413 keV in ^{186}Os and ^{188}Os respectively. (RWR)

20141 SINGLE-NEUTRON TRANSFER REACTIONS IN THE p + ^{172}Yb SYSTEM: OBSERVATION OF MULTI-STEP NUCLEAR PROCESSES. McVay, L. J. New Haven, CT; Yale Univ. (1973). 168p. University Microfilms Order No. 74-11,763.

Thesis (Ph. D.).

High-resolution experimental data are presented on the angular distributions of the ^{172}Yb(p, d) ^{171}Yb reaction at E_p = 17.00 MeV and of the inverse ^{171}Yb(d, p) ^{172}Yb reaction at E_d = 11.20 MeV and 16.00 MeV. The individual states in the low-lying deformed rotational bands of the ^{171,} ^{172}Yb nuclei were observed. A DWBA theoretical interpretation of these reactions was successful to an accuracy of 30%, below which a one-step theory evidently fails. This 30% limit is independent of the specific optical models used by the theory, because for the 11.2-MeV deuterons time-inverse reactions at the same total c.m. energy can be compared; however, the limit was derived by assuming the validity of the single-orbital adiabatic rotational model for the nuclei ^{171,} ^{172}Yb. A set of linear coupled equations for the distorted wave functions was solved; any number of intraband inelastic scatterings in addition to a single-neutron-transfer step could be handled. This coupled-channels Born approximation was much more successful than the one-step DWBA in describing the angular distributions of the weaker transitions. It was concluded that multistep processes are of crucial importance in neutron transfer reactions on deformed nuclei, and that when they are accounted for, the distorted-waves reaction theory and adiabatic rotational model can give a quite accurate description of the experimental data. (RWR)

20142 (n,γ) STUDIES ON Yb 172 AND Yb 174. Wimmer, L. (Technische Univ., Munich). Z. Naturforsch.; 28a: No. 2, 226-232(Feb 1973). (In German).

The Yb 171 (n,γ) and Yb 173 (n,γ) spectra have been measured in the energy region of 50–1, 650 keV with a bent crystal spectrometer. The high energy accuracy of the present data, permitting the application of the energy combination principle, and the high resolution, sufficient for the decomposition of close-lying doublets, have allowed detailed work on the level schemes of Yb 172 and Yb 174. The results confirm the existence of previously proposed levels, in particular through the observation of interband transitions between states above 1 MeV. Several additional levels were found. A $K = 0^+$ band is proposed at 1,405 keV in Yb 172. In Yb 174 a $K = 2^{(-)}$ band is seen at 1,606 keV. (3 figures, 4 tables) (auth)

20143 GAMMA–GAMMA DIRECTIONAL CORRELATIONS AND DETERMINATION OF MULTIPOLE MIXTURES IN ^{174}Yb AND ^{182}W. Schmidt, A. G. Notre Dame, IN; Univ. of Notre Dame (1974). 162p. University Microfilms Order No. 74-9236.

Thesis (Ph. D.).

E1 + M2 + E3 admixtures were observed for the $(2^- \rightarrow 2^+)$ transition depopulating the J^π, $K = 2^-$, 2 octupole vibrational levels in ^{174}Yb and ^{182}W. The γ–γ directional correlation for the $2^- \rightarrow 2^+ \rightarrow 0^+$ cascade in ^{174}Yb following the decay of ^{174}Lu and ^{174m}Lu was measured, and α_K for the $(2^- \rightarrow 2^+)$ 1242-keV transition was determined. These results yield a unique set of multipole mixing ratios. The M2 multipolarity of the $(2^- \rightarrow 0^+)$ 1318-keV transition was also verified from α_K measurements, and the multipole admixture for the $(2^- \rightarrow 4^+)$ 1065-keV transition was deduced. Directional correlations were measured for high-energy γ rays coincident with 100-keV and 229-keV ground-state band transitions in ^{182}W. The mixing ratios for the triple admixture in the $(2^- \rightarrow 2^+)$ 1189-keV transition depopulating the octupole level were determined. Triple admixtures were also unambiguously determined for the $(3^- \rightarrow 4^+)$ 1044-keV and $(3^- \rightarrow 2^+)$ 1274-keV transitions. Ratios of reduced transition probabilities were calculated and found to agree with rotational-

model predictions. The experimental B(E3; $2 \rightarrow 2^+$) values are compared with values obtained by using the rotational model branching rules and theoretical B(E3; $0^+ \rightarrow 3^-$) values from the microscopic model calculations (without Coriolis mixing). Partial correlation coefficients for the 992-keV transition depopulating the 1518-keV isomeric state in ^{174}Yb were determined. Multipole admixtures consistent with both directional correlation and existing internal conversion data are E2 + (26 ± 5% M1) for the choice of 6^+ and E1(68 ± 7%) + M2(5 ± 2%) + E3(27 ± 7%) for the choice of 7^- for the 1518-keV level. Hindrance factors were obtained for the K-forbidden transitions depopulating the level. (RWR)

20144 NUCLEAR DATA SHEETS FOR A = 189. Lewis, M. B. (Oak Ridge National Lab., TN). Nucl. Data Sheets; 12: No. 3, 397-430(Jul 1974).

Level schemes, spin and parity assignments, and decay properties are presented for all nuclei with mass number A = 189. Experimental data and adopted values are given along with conclusions as to the spin and parity assignments. The presentation of the nuclear properties is given in the light of the data and current theoretical ideas. In this transition region, level decay rates are seen to be of particular importance and so have been summarized in terms of multipole enhancement or hindrance. The compilers attempted to bring out some inconsistencies in the data and resolve discrepancies when possible. Deficiencies in the data include reaction data leading to states in ^{189}Pt, ^{189}Ir, ^{189}Os, and ^{189}Re. With the exception of ^{189}Os, the ground-state spins of A = 189 nuclei are not firmly established. The excitation energy of the isomeric level in ^{189}Pt is uncertain. The isomer decay in ^{189}Au has not been observed. In general, the level properties of ^{189}Ir and ^{189}Os show clear evidence of nuclear deformation. Level schemes for each of the A = 189 nuclei are presented first. Then for each nucleus are presented a summary of level properties, gamma or transition rate properties, and comments. Finally, the data and references are given for each nucleus. Energy units are keV unless otherwise noted. Adopted level and decay properties are based on data received before October 1973. (auth)

20145 HALF-LIFE OF THE FIRST EXCITED STATE IN ^{152}Gd. El-Aasser, M. R.; Awwad, Z. (Atomic Energy Establishment, Cairo). ATOMKI (At. Kut. Intez.) Kozlem.; 16: No. 2, 141-146 (1974).

The half-life of the 344.24-keV level in ^{152}Gd was measured by a comparison method in a delayed coincidence technique. A value of (37 ± 7) ps was found, and reduced transition probability and nuclear deformation parameters were deduced. (4 figures, 1 table) (auth)

20146 MULTISTEP PROCESSES IN NUCLEAR TRANSFER REACTIONS. King, C. H. Jr. New Haven, CT; Yale Univ. (1973). 285p. University Microfilms Order No. 74-11,755.

Thesis (Ph. D.).

A study was made of multistep nuclear transfer reaction processes involving inelastic excitations in the target and residual nuclei by investigating the reactions ^{186}W(p,t)^{184}W and ^{186}W(p,d)^{185}W. Complete angular distributions for these reactions at 18 MeV incident proton energy were measured in a magnetic spectrograph. Data were extracted for (p,t) transitions to states in ^{184}W up to 1225 keV excitation energy and for (p,d) transitions to states in ^{185}W up to 350 keV excitation energy. In both reactions several examples were noted of transitions involving transfer of the same orbital angular momentum but possessing significantly different angular distribution shapes, and this effect was interpreted as a possible result of the presence of multistep processes. To confirm this interpretation, coupled-channel Born-approximation (CCBA) calculations using the source-term method of Ascuitto and Glendenning were performed for (p,t) transitions to members of the ground and first-excited K = 0^+ bands in ^{184}W and for (p,d) transitions to members of the $\frac{1}{2}^-$[510] and $\frac{3}{2}^-$[512] bands in ^{185}W. The CCBA calculations, which include the effects of inelastic excitations to all orders but treat the transfer process to first order, were found to reproduce the experimental differential cross section much better than calculations using the distorted-wave Born approximation. It appears that many of the remaining discrepancies between the CCBA calculations and the experimental data can be attributed to uncertainties in the optical-potential parameters and in the parameters used to determine the nuclear structure of the states. It is shown that the inelastic processes affect not only the magnitudes but also the shapes of the angular distributions in such a way that extraction of angular momentum information on the basis of characteristic differential cross section shapes is questionable. (RWR)

20147 STUDY OF ENERGY LEVELS IN TUNGSTEN 183 POPULATED BY THE DECAY OF RHENIUM 183. Taylor, A. G. Logan, UT; Utah State Univ. (1973). 192p. University Microfilms Order No. 74-13,266.

Thesis (Ph. D.).

The electron-capture decay of ^{183}Re was studied by performing internal-conversion-electron measurements with a 35-cm, aircored, $\pi\sqrt{2}$ conversion-electron spectrometer, gamma-ray measurements with Ge(Li) spectrometers, and gamma–gamma coincidence experiments with a computer-controlled Ge(Li)–Ge(Li) coincidence spectrometer. Precise values of the gamma-ray intensities and mixing ratios were established for transitions in the daughter nucleus ^{183}W. These data formed the basis of a Coriolis mixing analysis of the low-lying (≤ 0.5 MeV) negative-parity states in ^{183}W. This analysis also made use of the recent single-nucleon-transfer reaction data from the literature. A reasonable fit to the energy level data of ^{183}W could be obtained with the Coriolis mixing of Nilsson-model states only by reducing the effective strength of the Coriolis-matrix elements to ~$\frac{1}{3}$ of their the theoretically predicted values. Furthermore, good energy-level values could be obtained only by using such reduced Coriolis-matrix elements and arbitrarily changing the sign of that matrix element which couples the $\frac{1}{2}$-[510] and $\frac{3}{2}$-[512] Nilsson states. However, (d,p) and (d,t) data indicate that this particular sign change is not allowed. The theoretical reasons for this discrepancy are not clear. This study provides no evidence for the feeding of the 309.5-keV isomeric state of ^{183}W in the ^{183}Re decay. An upper limit on the feeding of this isomeric state was placed 2.5 times lower than the feeding observed previously. (RWR)

20148 HEXADECAPOLE INTERACTION IN THE ATOMIC GROUND STATE OF ^{165}Ho. Dankwort, W.; Ferch, J.; Gebauer, H. (Bonn Univ. (F. R. Germany). Inst. fuer Angewandte Physik). Z. Phys.; 267: No. 3, 229-237(Apr 1974).

5 figs.; 3 tabs.; 30 refs.

Using the atomic beam magnetic resonance method several hyperfine transitions in the ground state of ^{165}Ho were measured at magnetic fields near zero Oe. Including a hexadecapole interaction constant D a perfect fit of the seven hyperfine separations was possible, allowing a determination of the hyperfine interaction constants A, B, C and D. Using a value of Fraga for the radial parameter $\langle r^{-5} \rangle$ a nuclear hexadecapole moment for ^{165}Ho can be calculated giving a value of 0.89×10^{-48} cm^4. Because of severe uncertainties still present in the theory for calculating the electronic matrix elements this value can be only regarded as highly speculative. (auth)

20149 REEVALUATION OF THE ATOMIC g(J)-FACTOR AND THE NUCLEAR g(I)-FACTOR OF ^{165}Ho. Dankwort, W.; Ferch, J.; (Bonn Univ. (F. R. Germany). Inst. fuer Angewandte Physik). Z. Phys.; 267: No. 3, 239-241(Apr 1974).

3 tabs.; 21 refs.

The measurements of Haberstroh, Moran and Penselin [Z. Phys. 252, 421(1972)] who determined the atomic g(J) factor and the nuclear g(I)-factor of ^{165}Ho, were reevaluated including the influence of higher fine structure levels and the deviation from LS-coupling. The results are g(I) = $-6.423(42) \times 10^{-4}$ and g(J) = 1.1951429(25). (auth)

20150 COULOMB EXCITATION OF GROUND BANDS IN ^{160,162,164}Dy WITH ^{20}Ne AND ^{35}Cl IONS. Sayer, R. O. (Furman Univ., Greenville, SC); Eichler, E.; Johnson, N. R.; Hensley, D. C.; Riedinger, L. L. Phys. Rev., C; 9: No. 3, 1103-1112 (Mar 1974).

Multiple Coulomb excitation of states up to $J^\pi = 12^+$ in the ground band was measured to test the rigid-rotor prediction for intraband B(E2) ratios. The deexcitation γ rays were observed in singles and in the particle-γ coincident mode following excitation by ^{20}Ne or ^{35}Cl ions from the Oak Ridge isochronous cyclotron. B(E2) values were extracted by comparing experimental excitation probabilities with theoretical values calculated with the Winther–de Boer computer code. An unexpected result is that the B(E2; $4 \rightarrow 6$) values for ^{162,164}Dy are 15 ± 5% smaller than the rotational values. However, the most striking variation of B(E2) with spin occurs for ^{160}Dy. We find $B(E2)_{exp} / B(E2)_{rotational}$ = 0.77 ± 0.05, 0.94 ± 0.06, and 1.29 ± 0.14 for the $4 \rightarrow 6$, $6 \rightarrow 8$, and $8 \rightarrow 10$ transitions, respectively. The $10 \rightarrow 8$ transition in ^{160}Dy is significantly faster than rotational even when our approximate quantal correction of 6% is not included in the analysis. (auth)

20151 COMMENTS ON E1 : M2 COMPETITION IN ^{154}Gd. Loebner, K. E. G. (Technische Univ. Munich, Garching, Ger.); Bunker, M. E. Phys. Rev., C; 9: No. 3, 1196-1197(Mar 1974).

An explanation is given for the contrast between the observed γ decay of the $K^\pi = 2,2^-$ octupole vibrational state in ^{154}Gd and the decay of the $2,2^-$ states in even–even nuclei near A = 180. (1 figure) (auth)

20152 COMPARISON OF ^{3}He-, ^{4}He-, AND ^{12}C-INDUCED NUCLEAR REACTIONS IN HEAVY-MASS TARGETS AT MEDIUM EXCITATION ENERGIES. II. Reaction Model Calculations.

Hofstetter, K. J.; Stickler, J. D. (Univ. of Kentucky, Lexington). Phys. Rev., C; 9: No. 3, 1072-1082(Mar 1974).

The excitation functions for neutron emission following fusion of ^{3}He, ^{4}He, and ^{12}C ions with a variety of heavy target nuclei, as determined in the previous communication, are compared to the statistical, exciton, and hybrid reaction model predictions. An initial exciton number of 5 is determined for α-particle-induced reactions by the simple exciton model. The initial exciton number of 7 is consistent with the ^{3}He-induced reactions by the exciton model. The hybrid-model predictions are found to be consistent with the ^{3}He- and ^{4}He-induced reactions using the initial exciton numbers of 3 and 4, respectively. The initial pre-equilibrium exciton states are assumed to be 2p-1n and 2p-2n pure particle states, respectively. The models permitting pre-equilibrium particle emission are not consistent with the data on ^{12}C-induced reactions; however, a statistical model calculation with level density parameter a = A/20 yields reasonable agreement with the cross sections. Angular momentum effects are discussed in terms of the model predictions and the isomer ratio for helion population of ^{186}Ir^{g} and ^{186}Ir^{m} are determined. (auth)

20153 EVIDENCE FOR THE NONPERIPHERAL CAPTURE OF HEAVY NEGATIVE PARTICLES BY TANTALUM. Bugg, W. M. (Univ. of Tennessee, Knoxville); Condo, G. T.; Hart, E. L.; Cohn, H. O. Phys. Rev., C; 9: No. 3, 1215-1216(Mar 1974).

A comparison of the data from previous experiments utilizing stopping $\bar{p}$ and K^{-} mesons in solid materials suggests that the nuclear capture of these particles may not be confined to the nuclear periphery in the case of tantalum. Other evidence supportive of this hypothesis is also presented. (1 table) (auth)

20154 COMPARISON OF ^{3}He-, ^{4}He-, AND ^{12}C-INDUCED NUCLEAR REACTIONS IN HEAVY-MASS TARGETS AT MEDIUM EXCITATION ENERGIES. I. Experimental Cross Sections. Stickler, J. D.; Hofstetter, K. J. (Univ. of Kentucky, Lexington). Phys. Rev.; C; 9: No. 3, 1064-1071(Mar 1974).

The excitation functions for the ^{197}Au(^{12}C, xn)$^{209-x}$At, ^{209}Bi(^{3}He, xn)$^{212-x}$At, ^{209}Bi(α, xn)$^{213-x}$At, ^{187}Re(^{3}He, xn)$^{190-x}$Ir, ^{187}Re(α, xn)$^{191-x}$Ir, and ^{197}Au(^{3}He, xn)$^{200-x}$Tl reactions were obtained by the activation method employing the stacked-foil technique. The maximum laboratory kinetic energies were 70-MeV ^{3}He, 80-MeV ^{4}He, and 120-MeV ^{12}C ions. The radiations accompanying the decay of the induced radioisotopes were detected by a calibrated Ge(Li) detector and the cross sections were deduced by the activation method. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 20113, 20126, 20132, 20152, 20154, and 20227.

20155 (RCN-203, pp 269-278) NEUTRON RESONANCES OF IRIDIUM ISOTOPES. Lason, L.; Malecki, H.; Pikelner, L. B.; Salamatin, I. M.; Sharapov, E. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Dec 1973. (In Russian).

From nuclear physics with thermal and resonance energy neutrons; Petten, Netherlands (22 May 1973).

Measurements of radiation capture cross sections of separated iridium isotopes ^{191}Ir, ^{193}Ir were performed by the time-of-flight method by using the pulse reactor IBR with linac. The energies of 106 resonances and $g\Gamma_n$ values for the majority of them were determined. (2 figures, 2 tables) (auth)

20156 NUCLEAR STRUCTURE OF BISMUTH 209: MACROSCOPIC AND MICROSCOPIC. Cleary, T. P. New Haven, CT; Yale Univ. (1973). 242p. University Microfilms Order No. 74-11, 656.

Thesis (Ph. D.).

Excitations in this "single-particle" nucleus are explored, macroscopically in terms of the coupling of the valence particle to the collective motion of the ^{208}Pb core–particle–vibration model–and microscopically in terms of two particle–one hole excitations with respect to the ^{208}Pb ground state–the shell model. The particle–vibration phenomena were examined by means of the ^{209}Bi (p, p′) reaction conducted at an incident proton energy of 16.10 MeV. Angular distributions for the scattered protons were compared with the results from a similar ^{208}Pb(p, p′) experiment. Levels associated with the coupling of the $h_{9/2}$ proton to the 3^{-}(3.615 MeV), 5^{-}(3.198 MeV), and 2^{+}(4.086 MeV) states of ^{208}Pb were identified and discussed in the context of the particle–vibration model. The 2p–1h structure of ^{209}Bi was investigated by studying the proton decay of the isobaric analog resonances in the compound nucleus ^{210}Po, populated by means of the ^{209}Bi(p, p′) reaction. In addition to an isobaric analog measurement performed at 14.95 MeV in the spectrograph, detailed excitation functions were measured from 14.0 to 15.5 MeV with solid state detectors at laboratory angles of 90° and 165°. This study permitted the identification of levels in ^{209}Bi involving the $h_{9/2}$ proton, $g_{9/2}$ neutron and $p_{1/2}$ neutron hole orbitals in their configurational structure as well as the ^{210}Bi parentage of these levels. On the basis of results from both the direct and analog experiments spins and parities for these levels are suggested. The results of a microscopic calculation in which the $h_{9/2}$, $g_{9/2}$ and $p_{1/2}$ orbital configurations were considered are reported and compared with the experimentally deduced level spectrum. The particle–vibration model is found to provide an excellent description of the multiplet of levels in ^{209}Bi based upon the coupling of the $h_{9/2}$ orbital to the ^{208}Pb octupole vibration; however, for groups of levels that can be associated with couplings to the less collective core states of ^{208}Pb, namely the 5^{-}(3.198 MeV) and 4^{-}(3.475 MeV) excitations, the experimental evidence strongly supports a shell-model approach in which the 2p–1h structure of these levels is considered explicitly. (Diss. Abstr. Int., B)

20157 STUDIES OF LEVELS IN EVEN MASS Hg AND Au NUCLEI IN THE RANGE A = 196-200 USING RADIOACTIVE DECAY AND IN-BEAM GAMMA-RAY SPECTROSCOPY. Cunnane, J. C. Lafayette, IN; Purdue University (1973). 179p. University Microfilms Order No. 74-4950.

Thesis (Ph. D.).

Levels in even-mass Hg and Au nuclei in the range A = 196 to 200 were studied in radioactive decay and in-beam γ-ray spectroscopy experiments. A new isomer, 2.27 ± 0.05-day ^{198m}Au, was discovered, which is believed to be analogous to the $(h_{9/2}\ \pi,\ i_{13/2}\ \nu)12^{-}$ isomer in ^{196}Au. No β^{-} branching is observed in the decay of ^{198m}Au. The isomeric transition is followed by a cascade of 204.10 and 180.31 keV γ-rays to a 123-ns level at 312.10 keV which deexcites to ground by a sequence of 97.21-keV (E1) and 214.89-keV (E2) transitions. A revised interpretation of the results of earlier (n, γ) and (d, pγ) studies of the ^{198}Au level structure is presented, and shell-model assignments for the levels populated in the isomeric decay are proposed. It is argued that the E1 de-excitation of the 123-ns isomer involves the l-forbidden single-particle transition $(d_{5/2}\ \pi,\ i_{13/2}\ \nu)5^{+} \rightarrow (d_{5/2}\ \pi,\ f_{7/2}\ \nu)4^{-}$. (Diss. Abstr. Int., B)

20158 DOORWAY STATES AND THE GIANT M1 RESONANCE IN ^{208}Pb. Brill, R. M. Providence; Brown University (1973). 126p. University Microfilms Order No. 74-2986.

Thesis (Ph. D.).

A calculation of the reaction ^{208}Pb(γ M1, n)^{207}Pb is performed (γ M1 indicates only reactions induced by the M1 component of the electromagnetic field are being considered). By using perturbation theory for the EM interaction, a doorway model and Feshbach's projection operator formalism, a general expression for the cross section is derived. Based on the shell structure of ^{208}Pb and the properties of the M1 transition operator, certain candidates for doorway states are assumed. Single-particle wave functions are generated in a Woods–Saxon potential, and a zero-range residual nucleon–nucleon interaction is assumed. For convenience, the cross section is put in a Breit–Wigner form and neutron-emission widths, radiative-transition widths, shift function, and direct photoemission term are calculated. The calculations show that the two doorway states and the radiative-transition and particle-emission widths are sensitive to the parameters of the zero-range residual interaction. The calculation yields a total radiative-transition width of about 90 eV, as compared to about 50 eV for experiment. The discrepancy between theory and experiment is probably due to the neglect of ground-state-correlation effects in the calculation. The calculation yields a total neutron-emission width of about 6 keV, as compared to about 8 keV for experiment. The calcualtions show that both the shift function and direct photoemission term are small. In conclusion, the calculation supports the validity of the doorway model for the ^{208}Pb(γ M1, n)^{207}Pb reaction. (RWR)

20159 CROSS SECTION AND THE RECOIL RANGE STUDY OF THE ^{209}Bi(p,n) AND (p,2n) REACTIONS. Miyano, K. (Niigata Univ., Japan); Nakahara, H. J. Phys. Soc. Jap.; 35: No. 4, 953-956(Oct 1973).

Cross sections and recoil ranges in ^{209}Bi (p, n) ^{209}Po ($T_{1/2}$ = 103y) and ^{209}Bi (p, 2n) ^{208}Po ($T_{1/2}$ = 2.92y) were obtained by counting α rays from the residual activities. The recoil ranges were found to be shorter than those expected from the full momentum transfer in the regions of the higher energy tails of the excitation functions. This fact shows that some direct mechanism must be taken into account in order to understand the (p, xn) reactions in heavy mass nuclei even at comparatively low bombarding energies. (auth)

20160 EC/β^+ RATIOS IN THE DECAY OF ISOTOPES ^{191,193,195,197}Tl. Imre, M.; Zoltan, M.; Ferenc, T. ATOMKI (At. Kut. Intez.) Kozlem.; 16: No. 2, 133-139(1974). (In Hungarian).

By using a gamma-detection technique (Ge(Li); KX, 511_{ann}) the EC/β^+ ratios were measured in the ground-state decay of light Tl isotopes. In the cases of ^{195,197}Tl, where the decay schemes had been known, the minimum values of the $(EC/\beta^+)_g$ ratio were determined for the transition $1/2^+ \rightarrow 1/2^-$ between ground states. This experimental value for ^{195}Tl is 6 times higher than the theoretically calculated $(EC/\beta^+)_{cg}$ for allowed transitions. (1 table) (auth)

20161 LEVEL DENSITIES IN NEAR DOUBLY MAGIC NUCLEI FROM (p,α) REACTIONS ON BISMUTH AND LEAD ISOTOPES. Gadioli, E.; Iori, I.; Molho, N.; Zetta, L. (Univ., Milan). Nuovo Cim.; 22A: No. 3, 398-419(1 Aug 1974).

The backward angle spectra of α-particles emitted in proton bombardment of ^{209}Bi and ^{206,207,208}Pb were measured at four bombarding energies between ≈30 and 45 MeV. The statistical contribution to the reactions was deduced, and compared with the theoretical estimate calculated by assuming that shell effects on level density are a consequence of the gap appearing in the sequence of single-nucleon states at the magic numbers. This comparison and the analysis of slow neutron resonance spacings determine a set of parameters that allow the reproduction of the energy dependence of level densities in the excitation energy interval ≈(4 to 5) to ≈45 MeV. (auth)

20162 STUDY OF THE RADIOISOTOPES PRODUCED BY THE INTERACTION OF 600-MeV PROTONS WITH GOLD NUCLEI: AN INSTRUMENTAL APPROACH. Lokken, R. A. Logan, UT; Utah State Univ. (1974). 198p. University Microfilms Order No. 74-13,239.

Thesis (Ph. D.).

An investigation of the reaction products resulting from the bombardment of thin gold foils with 600-MeV protons was performed. An instrumental method of investigation, employing high-resolution Ge(Li) spectrometer systems and computer programs designed for detailed gamma-spectrum analysis, was used in the determination of isotopic yields. The intensities of prominent gamma-ray peaks resulting from the decay of each observed radioisotope, together with decay scheme information taken from the literature, were used to determine relative yields. These were then normalized to the absolute yield of ^{185}Os. Over 65 radioisotopes with 46 < A < 196 were identified in the targets. Approximately 25 additional isotopes were tentatively identified. Yields ranged from 0.1 to more than 30 millibarns. Yields of several rare earth isotopes in the 0.01-mb range were measured from the data obtained from chemically separated samples. A total fission yield (for the mass region 44 < A < 125) was estimated to be 70 ± 18 mb, while the total interaction cross section was determined to be 980 ± 150 mb, whereas the geometric cross section of ^{197}Au is ~1830 mb. The major portion of the total experimental yield was found to occur in the "spallation" region, 145 < A < 196. A yield vs mass number curve is obtained. (RWR)

20163 SPECTRUM OF ^{205}Pb AS EXCITED BY THE (d,p) REACTION. Maguire, C. F. New Haven; Yale Univ. (1973). 225p. University Microfilms Order No. 74-12,489.

Thesis (Ph. D.).

Data were obtained at two incident energies, 13.0 and 20.0 MeV. Two types of states can be formed in this reaction: low-lying (≤2.57 MeV excitation) states consisting of three neutron holes in the N = 5 major shell and higher-lying one-particle-four-hole states with the neutron in the N = 6 major shell outside the four-hole ^{204}Pb core. The "hole" states are only very weakly excited, with less than half (15) the known low-lying states of ^{205}Pb excited above the 2 μb/sr limit of this study. The extracted spectroscopic factors for the "hole" states were compared with the predictions of three residual interaction calculations: phenomenological, realistic-Kuo-Brown series, and realistic-BCS. Only the last calculation remains uncontradicted by the present results. The present work established 110 states in ^{205}Pb $[(\partial\sigma/\partial\Omega)_{max} = 50\mu b/sr - 2000\ \mu b/sr)$ between 2.57 and 5.62 MeV, which are believed to be all fragments of the N = 6 orbitals. Spectroscopic factors were assigned for most of the states. The resulting distribution of shell strength, concentrated more or less narrowly about the centroids, confirms that the simple shell-model potential has not been overwhelmed by the residual interaction. However, the only theoretical prediction for this spectrum, in terms of the particle-vibration model, is found to give poor results. These data were analyzed by comparing the ^{204}Pb (d,p) ^{205}Pb angular distributions to those of the ^{208}Pb (d,p) ^{209}Pb reaction performed at the same incident energies to avoid the presumed uncertainties of the DWBA reaction calculation. (RWR)

20164 BACKGROUND (γ, n) CROSS SECTION IN ^{208}Pb. Jackson, H. E. (Argonne National Lab., IL). Phys. Rev., C; 9: No. 3, 1148-1152(Mar 1974).

A series of experimental estimates of the nonresonant radiative neutron reaction cross section in ^{208}Pb have been reported recently. To date, the results from (γ, n) studies have been inconsistent with measurements of neutron-induced reactions. In an effort to resolve this discrepancy, the shape of the 41-keV resonance in the reaction ^{208}Pb(γ, n)^{207}Pb has been studied in detail by simultaneous measurements of the photoneutron spectra at 90 and 135°. A small asymmetry in the resonance shape implies the presence of a background cross section of $1.3^{+0.5}_{-0.4}$ mb. This value can be explained in terms of contributions from neighboring resonances plus a small direct-reaction component; there is no evidence for anomalous processes. The result is consistent with the most recent data from study of the reaction ^{207}Pb(n, γ_0). (auth)

20165 ALPHA DECAY OF ^{215}Fr. Nomura, T.; Hiruta, K.; Yoshie, M.; Hashimoto, O. (Inst. of Physical and Chemical Research, Wako, Japan). Phys. Rev., C; 9: No. 3, 1168-1173(Mar 1974).

The α-decay property of ^{215}Fr was studied by the pulsed-beam method, in which ^{215}Fr was produced in the ^{209}Bi(^{12}C, α2n) reaction and its α decay was measured between natural beam bursts of the cyclotron. The ground state of ^{215}Fr was found to decay with E_α = 9.355 ± 0.010 MeV and $t_{\frac{1}{2}}$ = 0.12 ± 0.02 μs. The reduced α width of ^{215}Fr is shown to fit the systematical trend of N = 128 isotones very well and to agree with the simple shell-model calculation. Distributions of recoil angles for reaction products in the (^{12}C, α-xn) reaction were found to be quite different from those for (^{12}C, xn) products; a convenient method of distinguishing these reaction products is thus available. (7 figures) (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 20051, 20092, 20097, 20111, 20113, 20216, and 20255.

20166 (CONF-740637-1) TRANSNOBELIUM NUCLEI. Bemis, C. E. Jr. (Oak Ridge National Lab., Tenn. (USA)). 1974. 16p. Dep. NTIS $4.00.

From international conference on reactions between complex nuclei; Nashville, Tennessee, USA (10 Jun 1974).

The topic of transnobelium nuclei (102 < Z < 108) is surveyed. Current knowledge of the properties of the transnobelium nuclei, production methods and problems, methods of identification, and prospects for the synthesis of unknown species in this region are discussed. (5 figures, 1 table, 54 references) (RWR)

20167 (COO-2176-23) NEUTRON SPECTROSCOPY. Progress Report July 1, 1973-June 30, 1974. Havens, W. W. Jr.; Melkonian, E.; Felvinci, J. (Columbia Univ., New York (USA). Div. of Nuclear Science and Engineering). 1974. Contract AT(11-1)-2176. 29p. Dep. NTIS $4.50.

The continued unavailability of the Nevis synchrocyclotron forced experimentation at ORELA. These experiments were successful; data on ^{229}Th, ^{233}U, ^{235}U, and ^{239}Pu fission were taken and partially analyzed. A new way of presenting cross section vs energy, with energy intervals related to the resolution, is also described. Calculations were performed to study the bias introduced in fission cross section measurements by using ionization chambers. The results correspond to differences between different experiments. The pulse height effects in the fission fragment detection noticed at earlier Nevis runs were confirmed in both ^{233}U and ^{235}U. Several new small levels were identified, and some large levels, split through the study of the pulse height cuts. Additional structures in the cross sections of ^{235}U at low neutron energies were also noticed. Capture cross section measurements on ^{169}Tm and ^{197}Au were performed at ORELA by using Moxon-Rae detectors; good correspondence with earlier Nevis data was observed. The next Nevis run is scheduled to take place in Spring 1975, and preparations for this and for a run at ORELA are continuing. (15 figures) (auth)

20168 (GSI-tr-74/4) APPLICATION OF HEAVY-ION BEAMS IN FIELDS RELATED TO SCIENCE AND TECHNOLOGY. Flerov, G. N. (Gesellschaft fuer Schwerionenforschung m. b. H., Darmstadt (F. R. Germany)). Feb 1974. 17p. (In German). INIS.

4 figs. Translation of the Russian report JINR-P7-7571.

Some future aspects of the application of heavy-ion beams are reviewed: studies and experiments for the detection of a region of stable, super-heavy nuclei; detection and analysis of new elements and isotopes, new types of radioactive decay, and stable

antinuclei; investigation of hypernuclei and their excited states (new information on strong interactions between nuclei); investigations into the origin of elements and their distribution in the cosmos; studies on nuclei far from the region of stability, with extreme angular momentum and excitation energies; experiments concerning radiation-induced damage to materials used in reactor technology (materials testing); examination of changes in the composition of superconducting alloys in the search for high-temperature superconductors; and preparation of ultrafine 'nucleon pores' with the aid of heavy ions. (GE)

20169 (HEDL-TME-73-54) LMFBR REACTION RATE AND DOSIMETRY 8TH PROGRESS REPORT FOR PERIOD MARCH–SEPTEMBER 1973. McElroy, W. N. (Comp.). (Hanford Engineering Development Lab., Richland, Wash. (USA)). Feb 1974. Contract AT(45-1)-2170. 141p. Dep. NTIS $5.45.

This report was compiled at the Hanford Engineering Development Laboratory, operated by Westinghouse Hanford Company, a subsidiary of Westinghouse Electric Corporation, for the United States Atomic Energy Commission, Division of Reactor Research and Development, under Contract No. AT(45-1)2170. It describes technical progress made in the Interlaboratory LMFBR Reaction Rate Program during the reporting period. (auth)

For title listings of selected papers see: 19988, 20170–20175, 20405, and 20406.

20170 (HEDL-TME-73-54, pp ANC.17-ANC.18) FISSION PRODUCT ACTIVITIES MEASURED FOR IRRADIATIONS IN CFRMF. Greenwood, R. C.; Helmer, R. G. (Aerojet Nuclear Co., Idaho Falls, ID). Feb 1974.

In LMFBR reaction rate and dosimetry 8th progress report for period March–September 1973.

20171 (HEDL-TME-73-54, pp ANL.1-ANL.6) FISSION YIELDS AND THEIR RELATIONSHIP TO THE ILRR PROGRAM. Dudey, N. D.; Larsen, R. P. (Argonne National Lab., IL). Feb 1974.

In LMFBR reaction rate and dosimetry 8th progress report for period March–September 1973.

20172 (HEDL-TME-73-54, pp ANL. 7-ANL.13) REACTION RATES BY FOIL ACTIVATION (EMC AND CFRMF). Popek, R. J.; Dudey, N. D. (Argonne National Lab., IL). Feb 1974.

In LMFBR reaction rate and dosimetry 8th progress report for period March–September 1973.

20173 (HEDL-TME-73-54, pp ANL.14-ANL.15) ABSOLUTE FISSION RATES OF ^{239}Pu, ^{235}U, AND ^{238}U IN THE FTR-EMC TEST. Armani, R. J. (Argonne National Lab., IL). Feb 1974.

In LMFBR reaction rate and dosimetry 8th progress report for period March–September 1973.

20174 (HEDL-TME-73-54, pp ANL.16-ANL.22) ABSOLUTE FISSION RATE MEASUREMENTS BY THE TRACK RECORDER TECHNIQUE. Popek, R. J.; Dudey, N. D.; Armani, R. J. (Argonne National Lab., IL). Feb 1974.

In LMFBR reaction rate and dosimetry 8th progress report for period March–September 1973.

20175 (HEDL-TME-73-54, pp HEDL.20-HEDL.37) INFINITELY DILUTE REACTION RATES. McElroy, W. N.; Kellogg, L. S.; Lippincott, E. P. Feb 1974.

In LMFBR reaction rate and dosimetry 8th progress report for period March–September 1973.

20176 (ITF-74-25E) POSSIBILITY OF EXISTENCE OF MULTINEUTRON SYSTEMS. Antonchenko, V. Ya.; Bragin, V. N.; Simenog, I. V. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 8p. Dep. NTIS (US Sales Only) $4.00.

It is found that the multineutron systems with nonsaturating interaction potentials form a bound system with particle number $N \geq N_{crit}$, where N_{crit}, according to the type of forces, is within the interval $N_{crit} \sim 10^2$ to 10^3. (3 tables) (auth)

20177 (RCN-203) NUCLEAR PHYSICS WITH THERMAL AND RESONANCE ENERGY NEUTRONS. Proceedings of a Symposium Held at Petten, May 22–25, 1973. (Stichting Reactor Centrum Nederland, Petten). Dec 1973. 369p. (In Russian and English). (CONF-730592-).

Separate abstracts were prepared for 23 of the papers in this report. The remaining five have already appeared in NSA, with the following abstract numbers: 27: 29097, 28: 1359, 28: 16983, 29: 6494, and 29: 30750. (RWR)

For abstracts of individual papers see: 18796, 19940, 20022, 20057, 20058, 20092, 20113–20116, 20137, 20155, 20178–20187, and 20214.

20178 (RCN-203, pp 95-99) MASS DISTRIBUTION OF NEUTRON INDUCED FISSION FOR ^{239}Pu AT THE 0.297 eV RESONANCE. Van Assche, P. H. M. (SCK/CEN, Mol, Belg.); Vandenput, G.; Jacobs, L.; Van den Cruyce, J. M.; Silverans, R. Dec 1973.

From nuclear physics with thermal and resonance energy neutrons; Petten, Netherlands (22 May 1973).

The mass distribution of the fission products from the neutron-induced fission of ^{239}Pu at the 0.297-eV resonance was determined by comparing the gamma intensities of ^{239}Pu targets activated in thermal and epi-samarium neutron fluxes. The identification of fission products depended only on the observed gamma energies and half-lives, without any chemical separation on the Pu targets. (1 figure, 1 table) (RWR)

20179 (RCN-203, pp 100-112) NEUTRON MULTIPLICITY MEASUREMENTS ON RESOLVED FISSION RESONANCES OF ^{235}U AND ^{239}Pu. Theobald, J. P. (Central Bureau for Nuclear Measurements, Geel, Belg.); Wartena, J. A.; Weigmann, H.; Werz, R.; Poortmans, F. Dec 1973.

From nuclear physics with thermal and resonance energy neutrons; Petten, Netherlands (22 May 1973).

Neutron-induced fission events emitting 2, 3, 4, or 5 neutrons have different contributions to fission yields recorded with double and triple neutron coincidence signals as a function of incoming neutron energy. This fact can be used to search for variations of neutron multiplicities in fission resonances, in particular, in resonances of different channel spins. In the case of ^{235}U no difference in fission neutron numbers for 3^- and 4^- levels was detected above the experimental error of ±1.5%. In the case of ^{239}Pu there was also no clear correlation with the spin; however, a trend such that a lower neutron multiplicity goes with small Γ_f values was noted. (3 figures, 1 table) (auth)

20180 (RCN-203, pp 113-134) NEUTRON RESONANCE PARAMETERS OF ^{242}Pu. Poortmans, F. (SCK/CEN, Mol, Belg.); Rohr, G.; Theobald, J. P.; Weigmann, H.; Vanpraet, G. J. Dec 1973.

From nuclear physics with thermal and resonance energy neutrons; Petten, Netherlands (22 May 1973).

Capture, elastic scattering, and total cross section measurements were performed on ^{242}Pu below 1300 eV. The neutron widths, Γ_n, were obtained for 71 resonances, and the total radiative widths, Γ_γ, for 25 resonances. The s-wave strength function $S_0 = 0.89^{+0.33}_{-0.31} \times 10^{-4}$, and the average radiative width $\bar{\Gamma}_\gamma = [21.9 \pm 0.4\ (\text{stat.}) \pm 1.\ (\text{syst.})]$. The resonance parameters were used to calculate the fission widths, Γ_f, from the fission cross section results of G. F. Auchampaugh et al. [Nucl. Phys., A171: 31(1971)]. From these fission widths, the height of the second fission barrier was deduced: $E_B = 5.18$ MeV. (auth)

20181 (RCN-203, pp 135-146) COMPARISON OF THE THERMAL NEUTRON INDUCED FISSION OF ^{239}Pu AND THE SPONTANEOUS FISSION OF ^{240}Pu. Wegener-Penning, G.; Deruytter, A. J. (SCK/CEN, Mol, Belg.). Dec 1973.

From nuclear physics with thermal and resonance energy neutrons; Petten, Netherlands (22 May 1973).

The thermal-neutron-induced fission of ^{239}Pu and the spontaneous fission of ^{240}Pu were compared in a double kinetic energy measurement with solid state detectors. The method was such that systematic errors cancelled in the comparison. Kinetic energy and mass distributions were obtained, and the correlation between them was studied. The average preneutron total kinetic energy was found to be higher for the thermal-neutron-induced fission: 177.9 ± 0.04 MeV vs 176.8 ± 0.2 MeV for the spontaneous fission. Indicated errors are statistical. The shape of the mass distributions was similar in both cases; however, the valley was deeper and the peaks were narrower and shifted towards the symmetric point over 1 mass unit for spontaneous fission. Mass distributions for several groups of total kinetic energies showed that with increasing kinetic energy the peaks become narrower, the average heavy mass approaches 132, and apparent fine structure at lower kinetic energies washes out. (5 figures, 2 tables) (auth)

20182 (RCN-203, pp 147-168) TERNARY TO BINARY FISSION RATIO FOR NEUTRON INDUCED FISSION IN ^{239}Pu IN THE ENERGY REGION FROM 0.02 eV TO 50 eV. Wagemans, C. (SCK/CEN, Mol, Belg.); Deruytter, A. J. Dec 1973.

From nuclear physics with thermal and resonance energy neutrons; Petten, Netherlands (22 May 1973).

The measurements were performed at an 8.1-m flight path of the C. B. N. M. Linac at Geel. Binary and ternary fission fragments were consecutively counted with banks of surface barrier detectors on both sides of a double-faced ^{239}Pu sample. After correction for background and underlying cross sections, the areas of corresponding resonances in ternary (T) and binary (B) fission were derived; their ratio yielded the T/B value for the resonance considered. Moreover, the energy region through

the first large resonance from 0.02 eV to 1 eV was subdivided into several zones for which T/B values were also calculated. The T/B ratio seems not to vary significantly in the energy region from 0.02 eV to 50 eV, except for the 15.5-eV resonance where there was about 10% more ternary fission. Correlations of T/B with the resonance spin, J, and with other fission characteristics are discussed. (6 figures, 5 tables) (auth)

20183 (RCN-203, pp 169-171) FISSION ISOMER YIELD IN ^{235}U + n REACTION. Otroschenko, G. A.; Vorotnikov, P. E. (Inst. of Atomic Energy, Moscow). Dec 1973.

From nuclear physics with thermal and resonance energy neutrons; Petten, Netherlands (22 May 1973).

The fission isomer yield in the reaction ^{235}U + n was measured at 1 MeV. Measurements were done by using a van de Graaff accelerator with a 6-ns pulse duration and a Xe proportional counter. Correction for background, particularly the time-dependent component, is discussed at some length. The fission isomer yield was found to be $(0.4 \pm 2.8) \times 10^{-5}$ of the prompt fission yield (with 100 ns as assumed isomer lifetime). (RWR)

20184 (RCN-203, pp 172-193) ESTIMATION OF RESONANCE PARAMETERS OF CLASS II LEVELS USING THE MAXIMUM LIKELIHOOD METHOD. Werz, R.; Rohr, G.; Theobald, J. P.; Weigmann, H. (Central Bureau for Nuclear Measurements, Geel, Belg.). Dec 1973.

From nuclear physics with thermal and resonance energy neutrons; Petten, Netherlands (22 May 1973).

Doorway mechanisms often manifest themselves in such a manner that broad nuclear states of in general low density are coupled to narrow and dense ones through residual interaction. A clear and typical example of such a situation is given by the fission process through a double-humped fission barrier. The class I states (C-I-S), or usual compound-nucleus states, play the role of the narrow and dense states, while the class II states (C-II-S), built upon a shape isomeric ground state, stand for the broad levels. It has been shown in the framework of the picket fence model that the fission widths $\Gamma_{\mu f}$ of C-I-S coupled to a C-II-S follow a Lorentzian curve. In a more realistic model they fluctuate according to a Porter–Thomas distribution (PTD) around a Lorentzian. In the present paper it is assumed that in the more general case the Lorentzian determines the mean values of the PTD as a function of excitation energy. Under this assumption calculations were performed to estimate C-II-S parameters from $\Gamma_{\mu f}$ data. The quality of these parameters is discussed. (10 figures) (auth)

20185 (RCN-203, pp 279-285) CROSS SECTION MEASUREMENTS ON ^{236}U BELOW 2 keV. Mewissen, L. (SCK/CEN, Mol, Belg.); Poortmans, F.; Rohr, G.; Theobald, J. P.; Vanpraet, G. J.; Weigmann, H.; Werz, R. Dec 1973.

From nuclear physics with thermal and resonance energy neutrons; Petten, Netherlands (22 May 1973).

Elastic scattering, capture, and total cross section measurements were performed between 30 eV and 1800 eV. The neutron widths, Γ_n, were deduced for 99 levels; and the capture widths, for 56 levels. (3 figures, 1 table) (RWR)

20186 (RCN-203, pp 286-288) ESTIMATE OF THE RATIO $R = \bar{\Gamma}_f(3)/\bar{\Gamma}_f(4)$ FOR ^{235}U(n,f). Corvi, F.; Stefanon, M. (Central Bureau for Nuclear Measurements, Geel, Belg.). Dec 1973.

From nuclear physics with thermal and resonance energy neutrons; Petten, Netherlands (22 May 1973).

The knowledge of the spins of a considerable number of ^{235}U neutron resonances allows one to deduce an estimate of the average fission width per spin state, $\bar{\Gamma}_f(3)$ and $\bar{\Gamma}_f(4)$. Due to the complicated structure of the ^{235}U neutron cross section in the resonance region, different analyses of ^{235}U data have yielded very different values of Γ_f; therefore, an estimate of the ratio $R = \bar{\Gamma}_f(3)/\bar{\Gamma}_f(4)$ is given, in the hope that this quantity is less dependent on the particular analysis used. The calculation was carried out with the maximum likelihood method. The results are plotted as the average likelihood function, A (R), versus R. The most probable values lie around R = 3. This result is in agreement with Bohr's channel theory. (1 figure) (RWR)

20187 (RCN-203, pp 358-364) NEUTRON RESONANCE OF ^{235}U. Reddingius, E. R. (FOM-RCN Nuclear Structure Group, Petten, Netherlands); Postma, H.; Olson, C.; Rorer, D. C.; Sailor, V. L. Dec 1973.

From nuclear physics with thermal and resonance energy neutrons; Petten, Netherlands (22 May 1973).

Neutron resonance spins of ^{235}U were determined by measuring the transmission of polarized neutrons through a target with polarized ^{235}U nuclei. The sample was cooled by adiabatic demagnetization. The sample was in an external magnetic field of 28.7 kOe. The transmission effect, (Np – Na)/(Np + Na), was determined, where Np (Na) is the number of counts with parallel (antiparallel) polarization of neutrons and nuclei. It was found that $f_n \approx 0.50$ and $f_N \approx 0.055$, where f_n and f_N are the degrees of neutron and nuclear polarization, respectively. The cross section and transmission effect are shown for the energy region 1.7 to 15 eV. Neutron resonance spins of ^{235}U are tabulated for E_n from 0.275 to 14.0 eV. (2 figures, 1 table) (RWR)

20188 (SUNI-28, pp 6-7) COLLECTIVE BAND STRUCTURE OF ^{238}U. McMurray, W. R. (Southern Universities Nuclear Inst., Faure, South Africa). 1973.

20189 (UCID-16514) STATUS REPORT TO USNDC. Anderson, J. D.; Browne, J. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Jun 1974. Contract W-7405-Eng-48. 20p. Dep. NTIS $4.00.

A status report of the USNDC on work at Lawrence Livermore Laboratory is presented. The following areas are included: Standards; Neutron data applications; Nuclear data for safeguards; Basic science; and Controlled thermonuclear research applications. Two of the papers are separately title listed. (RWR)

For title listings of individual papers see: 19992 and 20190.

20190 (UCID-16514, pp 1; 2) ^{235}U FISSION CROSS-SECTION MEASUREMENT. Czirr, J. B.; Sidhu, G. S. 3 Jun 1974.

In status report to USNDC.

20191 MASS DISTRIBUTION IN THE FISSION OF ^{238}U BY 14 MeV NEUTRONS. Blachot, J.; Carraz, L. C.; Cavallini, P.; Chauvin, C.; Ferrieu, A.; Moussa, A. (CEN, Grenoble, France). J. Inorg. Nucl. Chem.; 36: No. 3, 495-501(Mar 1974). (In French).

The fission yields of twenty-eight mass chains were measured for the 14 MeV neutron induced fission of ^{238}U. Fission product gamma activities from ^{238}U were determined with a high resolution lithium drifted germanium detector. The fission yields were derived using only nuclear data of fission products. To test the method, the yields of twenty-one mass chains in the thermal neutron induced fission of ^{235}U were measured. For these two mass distributions, comparison with recent compilations were made. (auth)

20192 TOTAL NEUTRON CROSS SECTIONS OF ^{235}U, ^{238}U, and AND ^{239}Pu FROM 0.5 TO 15 MeV. Schwartz, R. B.; Schrack, R. A.; Heaton, H. T. II. (National Bureau of Standards, Washington, DC). Nucl. Sci. Eng.; 54: No. 3, 322-326(Jul 1974).

The total neutron cross sections of ^{235}U, ^{238}U, and ^{239}Pu were measured over the energy range 0.5 to 15 MeV by using the U. S. National Bureau of Standards electron linear accelerator as a pulsed neutron source. Neutron energies were measured by the time-of-flight method, with a resolution of 0.1 n/m. The measurement accuracy is estimated to be ± 1 %. The cross-section curve is smooth, with no observable fine structure. The data are in excellent agreement with recent results from the Rensselaer Polytechnic Institute, and in satisfactory agreement with the ENDF/B-III data file, except at the high- and low-energy ends of the energy range. (4 figures, 3 tables) (auth)

20193 EVALUATION OF ^{238}U NEUTRON CROSS SECTIONS FROM SPECTRAL MEASUREMENTS. Bluhm, H.; Fieg, G.; Werle, H. (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Sci. Eng.; 54: No. 3, 300-316(Jul 1974).

The neutron spectra on the central axis of a massive block of uranium depleted in the ^{235}U isotope were measured by using spherical proton-recoil and ^{3}He semiconductor-sandwich spectrometers. The experimental spectra are compared with calculated multigroup spectra obtained with a 208-group constant cross-section set which is based on KEDAK cross sections. By parametric variation of all relevant nuclear data, the sensitivity of the spectra to changes in the ^{238}U cross sections is determined. The ^{238}U capture and inelastic scattering cross sections are adjusted to bring the calculations in line with the experiment. It is shown that the resulting adjusted ^{238}U cross sections also lead to considerably better agreement between experimental and theoretical results for other fast assemblies which are sensitive to changes in the ^{238}U cross sections. (13 figures) (auth)

20194 YIELD OF SHORT-LIVED GAMMA-RAY EMITTING NUCLIDES FROM FAST-AND THERMAL-NEUTRON FISSION. Larsen, R. P.; Dudey, N. D.; Heinrich, R. R.; Oldham, R. D.; Armani, R. J.; Popek, R. J.; Gold, R. (Argonne National Lab., IL). Nucl. Sci. Eng.; 54: No. 3, 263-272(Jul 1974).

Yields were determined for the short-lived gamma-ray emitting nuclides ^{95}Zr, ^{97}Zr, ^{103}Ru, ^{131}I, and ^{140}Ba, produced in fission of ^{235}U and ^{239}Pu by both thermal and fast neutrons and in fission of ^{238}U by fast neutrons. The dependence of the yields on neutron energy was evaluated. The irradiations were carried out in an Argonne National Laboratory fast critical assembly and a thermal-neutron source reactor. The number of fission-product atoms produced in thin metal foils was established by direct gamma-ray

spectrometric assays on the foils. In the fast-neutron studies, the number of fissions in the foils was derived from solid-state fission-track recorders. These recorders contained nanogram amounts of the fissionable materials and were irradiated in close proximity to the foils. In the thermal-neutron studies, the number of fissions was obtained from the ^{137}Cs content and the ^{137}Cs fractional fission yield. For certain fission products, e.g., ^{95}Zr, the yields are in close agreement with those of the stable daughters, whereas for others, e.g., ^{140}Ba, the yields are significantly lower. In the neutron energy range from thermal to 450 keV, relative changes of <1% are observed in the yields of all ^{239}Pu fission products and of the major ones for ^{235}U. The yields of ^{103}Ru and ^{131}I from ^{238}U increase significantly in this energy range and appear to have a logarithmic neutron-energy dependence. (2 figures, 9 tables) (auth)

20195 COMPARISON OF GROUP CONSTANTS USING SINGLE- AND MULTI-LEVEL FORMULAS FOR THE RESOLVED RESONANCE REGION OF URANIUM-235 AND URANIUM-233. Otani, H.; Ohmura, H.; Kobayashi, K. (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo); 10: No. 12, 709-718(Dec 1973).

By using the single-level and the Adler–Adler multi-level resonance formulas for ^{235}U, whose parameters were derived by fitting to common experimental data, group constants were obtained for the energy region from 59.8 to 0.215eV, having the same group structure as the 70 group JAERI-FAST set. It was found that use of the multi-level formula is preferable to the single-level alternative, the former being able to reproduce the experimental data more accurately than the latter. The resulting difference in the values of the group constants amounted to about 40% for some groups. The group constants of ^{233}U, determined by means of the multi-level formula, are presented for the energy region from 36.0 to 0.215eV. (auth)

20196 CHARGED PARTICLES EMITTED WITH ELEMENTS PRODUCED IN CALIFORNIUM-252 SPONTANEOUS TERNARY FISSION. Mirell, S. G. Tempe, AZ; Arizona State Univ. (1974). 131p. University Microfilms Order No. 74-9892.

Thesis (Ph. D.).

The energy spectra and yields of particles for Z = 1,2 emitted in the spontaneous fission of ^{252}Cf were measured in coincidence with Mo and Tc K x rays. The particle spectra were obtained from a surface barrier detector with a removable absorber foil; computer analysis separated the Z = 1 and Z = 2 spectra from the accumulated data taken with and without the absorber foil. The recorded particles were from fission events involving Mo or Tc fragments; this was determined by the coincident signal of a high-resolution lithium-drifted silicon spectrometer gating separately on Mo and Tc K x rays. The other fragment charge in each fission event was then inferred, thereby giving the total charge distribution of the fission products for the four charge combinations studied. The Z = 1 to 2 production ratio was found to be, respectively, 1 : 6.3 for Mo-associated fission processes, 1 : 4.8 with Tc fragments, and 1 : 15.1 without x-ray coincidence. The broad, singly peaked Z = 1,2 spectra had maxima at energies (MeV) 9.0 ± 0.5, 17.1 ± 0.2 for Mo coincidence and 9.8 ± 0.5, 17.8 ± 0.2 for Tc coincidence. (Diss. Abstr. Int., B)

20197 ABSOLUTE YIELDS IN THE FISSION OF ^{235}U BY MONO-ENERGETIC NEUTRONS OF ENERGY 130 TO 1700 KeV. Cuninghame, J. G.; Goodall, J. A. B.; Willis, H. H. (Atomic Energy Research Establishment, Harwell, Eng.). J. Inorg. Nucl. Chem.; 36: No. 7, 1453-1457(Jul 1974).

The absolute fission yields of ^{99}Mo, ^{111}Ag, ^{140}Ba, ^{147}Nd and ^{153}Sm were measured in ^{235}U fissioned by neutrons of energies 130, 300, 700, 900, 1300 and 1700 keV. The yields of ^{99}Mo, ^{140}Ba and ^{147}Nd are constant within standard deviations of ± 3.5, 3.3 and 4.7%, respectively, over the whole of the energy range. Those of ^{111}Ag and ^{153}Sm increase with increasing energy as the valley of the mass yield curve rises and the wings splay out. (auth)

20198 THERMAL CROSS-SECTION AND THE RESONANCE INTEGRAL OF ^{231}Pa: ACTIVATION DETERMINATION WITHOUT USING A Cd-FILTER. Gryntakis, E. M.; Kim, J. I. (Technische Univ. Muenchen, Garching, Ger.). J. Inorg. Nucl. Chem.; 36: No. 7, 1447-1452(Jul 1974).

Activation measurements of the thermal neutron cross section and the resonance integral (excluding 1/v contribution) of ^{231}Pa have given values of 201 ± 22 barn and 1432 ± 187 barn, respectively. Differentiation of thermal and resonance neutrons was made by conducting the irradiations in different neutron spectra and evaluating the effects of neutron temperature and of the resonance component of the effective cross section. Use of the Cd-filter is avoided in order to evaluate the first and second resonances at 0.396 eV and 0.494 eV which contribute 76 per cent of the total resonance integral. The values reported here are mainly based on measurements of the ^{232}Pa activity. (auth)

20199 PROMPT NEUTRON SPECTRA FROM SPONTANEOUS FISSION OF ^{252}Cf, ^{244}Cm, AND ^{240}Pu. Aleksandrova, Z. A.; Bol'shov, V. I.; Kuznetsov, V. F.; Smirenkin, G. N.; Tarasko, M. Z. At. Energ. (USSR); 36: No. 4, 282-285(Apr 1974). (In Russian).

Prompt neutron spectra for spontaneous fission of ^{252}Cf, ^{244}Cm, and ^{240}Pu in the neutron energy interval 1 to 14 MeV were determined by using a single-crystal scintillation spectrometer based on stilbene with time discrimination of gamma-quanta emission. The results exhibit a Maxwellian-type distribution. For these three isotopes, the parameters of this distribution are determined and compared with data given in the literature. (1 figure, 2 tables) (auth)

20200 EFFECTIVE NEUTRON ABSORPTION CROSS-SECTIONS FOR CALIFORNIUM, EINSTEINIUM, AND FERMIUM NUCLEI IN THE CENTRAL CHANNEL OF THE SM-2 REACTOR. Anufriev, V. A.; Gavrilov, V. D.; Zamyatnin, Yu. S.; Ivanenko, V. V. At. Energ. (USSR); 36: No. 4, 286-290(Apr 1974). (In Russian).

The effective neutron absorption cross sections for ^{252}Cf, ^{253}Cf, and ^{253}Es nuclei were measured in the central channel of a SM-2 reactor, and estimates were made for ^{254}Cf, ^{254m}Es, and ^{254}Fm nuclei. The methods used are described; and factors affecting the accuracy of results, analyzed. It is noted that the experimental values of $\sigma_{n\gamma}$ ^{252}Cf = (63 ± 9)b, σ_{nf} ^{253}Cf = (5300 ± 950)b, and $\sigma_{n\gamma}$ ^{253}Es = (980 ± 90)b significantly exceed values for other reactors. (5 figures, 1 table) (auth)

20201 TOTAL SPONTANEOUS FISSION HALF-LIFE, MASS, AND CHARGE DISTRIBUTION OF ^{253}Cf. Hooshyar, M. A. (Arya-Meher Univ. of Tech., Tehren); Malik, F. B. Helv. Phys. Acta; 46: No. 5, 720-723(1973).

The total spontaneous-fission half-life, mass, and charge distribution in the decay of ^{252}Cf were examined in the context of the recently proposed coupled-channel decay theory of fission; substantial agreement with observed data was found. (1 figure, 1 table) (auth)

20202 TOTAL SPONTANEOUS FISSION HALF-LIVES, KINETIC ENERGY, AND MASS YIELD SPECTRA OF ^{250}Cm, ^{254}Cf, AND ^{258}Fm. Hooshyar, M. A. (Arya-Meher Univ. of Tech., Teheren); Malik, F. B. Helv. Phys. Acta; 46: No. 5, 724-728(1973).

The absolute spontaneous fission half-lives of ^{250}Cm, ^{254}Cf, and ^{258}Fm, the preference of ^{258}Fm to decay in symmetric modes and trends of half-lives of even curium and californium isotopes are accounted for within the context of a theory of fission using an interaction characterized by a thin external barrier. (3 figures, 1 table) (auth)

20203 STRUCTURE OF THE FISSION TRANSITION NUCLEUS ^{227}Ra. Groening, H. R. Corvallis, OR; Oregon State Univ. (1974). 265p. University Microfilms Order No. 74-13,413.

Thesis (Ph. D.).

The character and positions of the first few single-particle levels in the transition nucleus ^{227}Ra were deduced from the available experimental data on the $^{226}Ra(n,f)$ reaction at neutron energies between 3.6 and 4.1 MeV. A Hauser–Feshbach calculation was carried out in which the fission cross section and the fission-fragment angular distributions were simultaneously fitted. In order to calculate the probability of neutron emission from the ^{227}Ra compound nucleus, the excitation energy dependence to the level density in Ra was assumed to be similar to the one in thorium. The level density in the latter was deduced from neutron evaporation data at low energies in ^{232}Th and neutron resonance information in ^{230}Th. The Hauser–Feshbach calculation was conducted for two different assumptions regarding the nuclear shape at the saddle point. In one case, the shape of the transition nucleus was assumed to be reflection-symmetric, in the other, asymmetric. The results of the calculation agree well with the theoretical predictions of Nix and Möeller as to the number and character of the single-particle levels and the height of the fission barrier for ^{227}Ra, which was found to be E_f = 8.2 ± 0.1 MeV. Calculations extended to higher incident neutron energies (4.7 MeV < E_n < 9.0 MeV) indicate that collective effects in the nuclear level density have been consistently underestimated at the equilibrium as well as at the saddle point deformations by a factor of about 10^3. Analysis of the fission-fragment angular distributions at moderate energies suggested a tentative value of the pairing gap parameter, Δ_f, considerably larger than the corresponding one at the equilibrium deformation ($\Delta_f \sim 1.7\Delta_0$). (Diss. Abstr. Int., B)

20204 INTERACTION OF 300-GeV PROTONS WITH URANIUM. Chang, S. K.; Sugarman, N. (Univ. of Chicago). Phys. Rev., C; 9: No. 3, 1138-1142(Mar 1974).

The cross sections and thick-target recoil properties of 30 nuclides produced in the interaction of 300-GeV protons with a

^{238}U target have been measured. The cross sections were determined relative to the monitor reaction ^{27}Al(p, 3pn)^{24}Na, whose cross section was assumed to be constant above 10 GeV. The average cross section of all products is found to be ~10% lower at 300 GeV than at 11.5 GeV. The recoil ranges of observed nuclides are ~8% shorter than at lower proton energy and F/B values are closer to unity. A preliminary study of the effect of secondary particles is presented. (auth)

Nuclear Theory

Refer also to abstract 19865.

20205 (CONF-740637-2) ELASTIC AND INELASTIC HEAVY ION SCATTERING. Satchler, G. R. (Oak Ridge National Lab., Tenn. (USA)). 1974. 17p. Dep. NTIS $4.00.

From international conference on reactions between complex nuclei; Nashville, Tennessee USA (10 Jun 1974).

The most interesting spatial region in a nuclear collision is the peripheral region, where one samples the tail of the nuclear potential. When plotted against distance of closest approach, cross sections remain Rutherford until D = D_0 is reached, where they fall exponentially. D_0 corresponds to the outer limit of the peripheral region. As illustrated for 72-MeV ^{16}O on ^{28}Si, even when absorption is almost complete, only the low (≲10%) density regions of the two ions overlap (classically). It is pointed out that all available information (inelastic scattering, transfer reactions, etc.) must be used in studying potentials; a potential can fit elastic scattering well, but be completely unacceptable when compared with experimental data on transfer reactions (for example). It is also shown that obtaining the data with the necessary precision requires a great deal of experimental effort. The following topics are treated: general properties of scattering, the optical model, ambiguities and ^{11}B + ^{208}Pb, folding models, folding and ^{12}C + ^{208}Pb, lighter targets: ^{16}O + ^{28}Si, and inelastic scattering. (17 figures) (RWR)

20206 (COO-3001-70) RESEARCH IN THEORETICAL NUCLEAR PHYSICS. Progress Report. Arima, A.; Brown, G. E.; Jackson, A. D.; Kuo, T. T. S. (State Univ. of New York, Stony Brook (USA)). 1974. Contract AT(11-1)-3001. 26p. Dep. NTIS $4.50.

After a general overview of the research effort in theoretical physics at SUNY, Stony Brook, brief descriptions (about a page) of problems completed and proposed are given. They can be classified as follows: Fundamental interactions of nucleons; Structure of finite nuclei; Effective interactions, nuclear models, and many-body theory; Pion–nucleus interactions and condensates; Reactions: nuclear and high-energy; and mathematics. (RWR)

20207 (COO-3494-12) NUCLEAR REACTION MECHANISMS. Progress Report, May 1973–June 1974. Blann, M. (Rochester Univ., N. Y. (USA)). 1974. Contract AT(11-1)-3494. 28p. Dep. NTIS $4.50.

Research under the subject contract was directed along two major lines: development and exploration of pre-equilibrium statistical models and experimental measurement and theoretical investigation of heavy-ion reaction mechanisms, with emphasis on the limits on compound-nucleus formation. Much of the work under this contract has been published, and a list of publications is part of this report. This work is not otherwise summarized herein. New unpublished results on heavy-ion reactions are briefly summarized, as are results of precompound α emission. Colloquia and addresses are also summarized. (auth)

For title listings of individual papers see: 20074 and 20208.

20208 (COO-3494-12, pp 6-11) PRECOMPOUND DECAY CALCULATIONS: A GENERAL MODEL APPROACH. Mignerey, A.; Scobel, W.; Blann, M. 1974.

In nuclear reaction mechanisms.

20209 (ITF-74-35P) SPECTRUM OF MONOPOLE AND QUADRUPOLE EXCITATIONS OF MAGIC NUCLEI WITH ANHARMONIC TERMS TAKEN INTO ACCOUNT. Steshenko, A. I. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1974. 28p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

The solutions of equations are obtained for monopole and quadrupole vibrations with anharmonic terms of kinematic and dynamic nature being taken into account. These equations arise in the main approximation of a generalized hyperspheric function method for the wave function which describes collective motions in magic nuclei. The effect of anharmonicity on a spectrum of the lowest monopole excitations as well as on the value of nuclear binding energy is considered. Special calculations are performed for different variants of nucleon–nucleon forces for ^{16}O and ^{40}Ca. (2 figures, 2 tables) (auth)

20210 (JINR-P4-7907) ROTATIONAL INVARIANCE AND EFFECTIVE CHARGES FOR E2 TRANSITIONS WITH ΔK = 1 IN ODD-MASS NUCLEI. Baznat, M. I.; Pyatov, N. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 28p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

It is shown that the rotational invariance of an arbitrary axially-symmetric nuclear potential can be restored with the aid of effective factorized two-body forces whose form and strength parameters are associated with the nonspherical part of the potential. The Hamiltonian obtained according to this method is applied to the description of $K^\pi = 1^+$ excitations in even-even deformed nuclei. In RPA those excitations are separated into rotational and vibrational branches. In odd-mass nuclei the polarization effects arising from the coupling of quasi-particle to vibrational 1^+ states of the core are considered. In particular, this coupling leads to a renormalization of one-particle matrix elements of E2 transitions with ΔK=1. The renormalization may be reduced to dynamic (configuration dependent) effective charges. The calculated charges are shown. The interband E2 transitions in ^{235}U were considered within the framework of the intermediate coupling model. The B(E2, ΔK = 1) values are, to the leading order, due to the Coriolis coupling of states but the contribution from single-particle transitions reduced these values by as much as 20 to 30%. (auth)

20211 (LA-UR-74-880) POTENTIAL-ENERGY SURFACES FOR HEAVY-ION COLLISIONS. Nix, J. R.; Sierk, A. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1 Jun 1974. Contract W-7405-eng-36. 31p. (CONF-740646-1). Dep. NTIS $4.75.

From nobel symposium on superheavy elements; Ronneby, Sweden (10 Jun 1974).

The nuclear potential energy of deformation is calculated for the collision of two heavy nuclei by means of a macroscopic–microscopic method. The nuclear macroscopic energy is calculated in terms of a double volume integral of a Yukawa function, and the microscopic shell and pairing corrections are calculated by use of Strutinsky's method from the single-particle levels of a realistic diffuse-surface single-particle potential. The time evolution of the system after the point of first contact is determined by solving the classical equations of motion for incompressible, irrotational hydrodynamical flow. The effect of nuclear viscosity on the fusion path is to slow down the formation of the neck and to inhibit the excitation of collective shape vibrations. For nuclear systems in which the fission saddle point lies well outside the contact point it is possible to interpret experimental fusion cross sections at relatively low bombarding energies in terms of a one-dimensional interaction barrier, as is customarily done. For heavier nuclear systems and higher bombarding energies, where the larger Coulomb and centrifugal forces tend to deform the fusing nuclei and lead to immediate fission, only those dynamical paths that pass inside the fission saddle point contribute significantly to fusion. (6 figures) (auth)

20212 (LBL-2905) CLASSICAL AND QUANTUM MECHANICAL DESCRIPTIONS OF HEAVY-ION INTERACTIONS. Glendenning, N. K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1974. Contract W-7405-eng-48. 34p. (CONF-740637-3). Dep. NTIS $4.75.

From international conference on reactions between complex nuclei; Nashville, Tennessee, USA (10 Jun 1974).

The aspects of classical scattering which are useful in understanding the dependence of heavy-ion reactions on the physical quantities governing the interaction are reviewed. The ways in which classical scattering can be used to suggest how to choose experiments that may be decisive in answering specific questions are emphasized. The work is illustrated by calculations of elastic and inelastic scattering of ^{18}O + ^{120}Sn, and the two-nucleon-transfer reaction ^{120}Sn (^{18}O, ^{16}O). A variety of different angular distributions for two-nucleon transfer (believed typical of multinucleon transfer) are shown; their exact form depends on the assumptions made about the interaction region corresponding to an interpenetration of the two nuclei. To answer the outstanding questions about this region and the dynamics of the reaction for these collisions, there is required a wealth of experimental data taken at angles both forward and back of the grazing angle and at close angular intervals (so as not to miss sharp minima). The structure of the S matrix, both as a function of l and decomposed into separate components corresponding to specific processes, provides valuable insights. For reactions in which many hundreds of angular momenta are involved, a two-part approach to calculating the S matrix was suggested; quantum mechanics is used for the region where the nuclear force is dominant, and semiclassical or semiquantal methods are employed for the high-l region, where the smooth behavior of S even permits an interppolation between widely spaced l's. (33 figures, 5 tables) (RWR)

20213 (N-71-26811) HIGH ENERGY NUCLEON–NUCLEON AND PION–NUCLEON COLLISION MODEL FOR NUCLEOR CASCADE. Final Technical Report. Matlock, R. L. (Louisiana State Univ., Shreveport (USA)). 1970. 18p. (NASA-CR-115041). NTIS.

A model for the description of nucleon–nucleon and pion–nucleon collisions at high energy and incorporation of this model into a complete Monte-Carlo description of a Nucleor Cascade is discussed. The effort in this research was directed toward calculating, based on the Hagedorn model, the momentum and particle number distributions necessary for a Monte-Carlo description of a Nuclear Cascade. The required momentum distributions, for the case of proton–proton collisions, were readily available from Hagedorn's calculations. The momentum distributions for the pion–proton case were worked out by the author in collaboration with Dr. Hagedorn. It is worth noting here that the distributions for the pion–proton case need further experimental verification in order to insure their validity. (STAR) (auth)

20214 (RCN-203, pp 69-74) CHANNEL SPIN INTERFERENCE AND POTENTIAL CAPTURE OF NEUTRONS. Abrahams, K.; Kopecky, J.; Stecher-Rasmussen, F. (FOM-RCN Nuclear Structure Group, Petten, Netherlands). Dec 1973.

From nuclear physics with thermal and resonance energy neutrons; Petten, Netherlands (22 May 1973).

Interference of channels with spin $J_c = J_t \pm \frac{1}{2}$ has been found for capture of slow neutrons. In the case of polarized-neutron capture, the extreme value, R, of the circular polarization of the emitted dipole radiation can be defined. If the reduced (n,γ) strength is highly correlated with the (d,p) spectroscopic factor for p levels, it can be shown that $R = (\theta^2_{\frac{1}{2}} - 0.5\theta^2_{\frac{3}{2}})/\theta^2$, where $\theta^2_{\frac{1}{2}}$ is the $p_{\frac{1}{2}}$ reduced width, $\theta^2_{\frac{3}{2}}$ the $p_{\frac{3}{2}}$ reduced width, and $\theta^2 = \theta^2_{\frac{1}{2}} + \theta^2_{\frac{3}{2}}$. One can thus derive $\theta^2_{\frac{1}{2}}$ and $\theta^2_{\frac{3}{2}}$ for each final state by measuring R. Such a measurement can be used to estimate the spin–orbit splitting for even-A nuclei. For the odd–odd nucleus ^{56}Mn the first $p_{\frac{1}{2}}$ level appears rather close to the ground state, just as for the odd-A nuclei in this mass region. Another group of $p_{\frac{1}{2}}$ levels is found at higher excitation energy, just as for the odd-A nuclei. For all measured odd-N nuclei in the mass region $48 < A < 62$ such a $p_{\frac{1}{2}}$–$p_{\frac{3}{2}}$ doublet has been found. For ^{58}Fe the relative $p_{\frac{1}{2}}$ and $p_{\frac{3}{2}}$ strengths have been determined for 15 levels. The $p_{\frac{1}{2}}$ levels appear 1 to 2 MeV above the strongest $p_{\frac{3}{2}}$ level. (RWR)

20215 (ZFK-133) SIGNIFICANCE OF THE PAULI PRINCIPLE AND CHARGE INVARIANCE OF NUCLEAR FORCES FOR NUCLEAR STRUCTURE AND NUCLEAR PROCESSES. Mueller, K. (Deutsche Akademie der Wissenschaften zu Berlin (German Democratic Republic); Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Mar 1968. 63p. (In German). Dep. NTIS (US Sales Only) $6.25.

A concise overview of the new material essential to the development for the entire region of low-energy nuclear structure studies is given first. This includes the excitation of analog states in the final nucleus through charge exchange reactions (quasi-elastic and quasi-inelastic scattering), the excitation of analog states as intermediate nuclear resonances (analog resonances) in elastic and inelastic proton scattering, and the excitation of analog states in the final nucleus through (d,p) reactions or other neutron-transfer reactions, as well as the structure information (like reduced widths and spectroscopic factors) obtainable from such experiments. Next, the governing equations are established. The discussion advances from only the Pauli principle and the charge invariance of nuclear forces; special nuclear models are not introduced. The theory is built up step-by-step. First, only the very simplest case is handled: processes in which only the excess neutrons are considered. Then the theory is enlarged to include several channels, but in a restricted space. Finally, the theory is generalized to real nuclei. (13 figures) (RWR)

20216 SIMPLIFIED MICROSCOPIC APPROACH TO NUCLEAR DEFORMATION ENERGY SURFACES. Ko, Che–Ming. Stony Brook, NY; State University of New York (1973). 188p. University Microfilms Order No. 74-6765.

Thesis (Ph. D.).

By approximating the Hartree–Fock self-consistent single-particle wave functions by those obtained from the deformed Woods–Saxon potential, the complicated CHF calculations of the nuclear deformation energy surface were reduced to the evaluation of simple expectation values. When the Skyrme interaction was used as the effective interaction among nucleons, the deformation energy surface of ^{240}Pu was obtained through straightforward evaluations of these expectation values. The resulting deformation energy surfaces are seen similar in topology to that of the Strutinsky shell-correction calculations. The quantitative differences are mainly due to the large surface coefficient inherent in the Skyrme interaction. By either increasing the magnitude of the surface coefficient in the liquid-drop model (to recalculate the Strutinsky energy surface) or by readjusting the Skyrme parameters, almost identical energy surfaces were obtained from these two different approaches. These calculations thus provide, for the first time, a direct comparison of the Strutinsky calculations with a simplified microscopic calculation. Various effects on the deformation energy surface were studied in detail. Pairing effects are seen to be important, but the surface pairing does not affect the deformation energies much more than the constant pairing does. The scale transformation is helpful in lowering the total binding energies of the nucleus. Center-of-mass corrections are small and do not change appreciably with deformations. However, rotational corrections are important and increase substantially with deformations. (Diss. Abstr. Int., B)

20217 CALCULATION OF THE REACTION MATRIX AND ITS APPLICATIONS TO ^{16}O. Tsai, S. F. Stony Brook, NY; State University of New York (1973). 129p. Microfilms Order No. 74-6766.

Thesis (Ph. D.).

A new solution for the nuclear G matrix is derived. In this solution, the projection-operator-dependent part of the G matrix is separated out as an additive term and can be evaluated conveniently without solving any coupled integral equations. The combination of this solution with the momentum-space matrix inversion method provides a very simple and promising method for the calculation of the nuclear G matrix. G-matrix elements off-diagonal in the center-of-mass harmonic oscillator radial quantum number, which can not be obtained by using previous methods, are calculated and shown to be small, typically less than 5% of the neighboring diagonal matrix elements. Calculations using angle-average approximation for the projection operator are found to give essentially the same G-matrix elements. A RPA equation previously derived by Bradnow for treating particle–hole excitations is elaborated and applied to calculate the energy spectra of 1^- and 3^- states of ^{16}O. The vertices include 2p–2h core polarizations. The results are typical of realistic calculations of the same kind. A calculation of the isotope shift in the proton mean-square radius of ^{16}O–^{17}O is performed. The shift is found to be far smaller than the $A^{\frac{1}{3}}$ law prediction, but is of the right sign. (Diss. Abstr. Int., B)

20218 PARTICLE–HOLE EXCITATIONS IN OPEN-SHELL NUCLEI. Ngo-Trong, C. Toronto; Univ. of Toronto (1972). National Library of Canada, Ottawa.

Thesis (Ph. D.).

The equations-of-motion approach is adopted for nuclear spectroscopic calculations. General equations of motion are derived where the assumption of a scalar ground state is no longer necessary. The equations are then used to define the Open-Shell Random Phase Approximation, an extension of the traditional Random Phase Approximation to more complex nuclei. Some formal properties of the OSRPA solutions and various expressions used to construct the eigenvalue equation and to evaluate its matrix elements are given. As an application, negative-parity states of the even isotopes of Nickel are calculated. Isospin is assumed to be a good quantum number. The results obtained agree well with existing experimental data. In particular, various features of the giant dipole resonances in ^{58,60}Ni can be explained in terms of an isospin structure. Large electromagnetic and isoscalar transition rates are also found for the octupole vibration. (Diss. Abstr. Int., B)

20219 EXACT TREATMENT OF COLLECTIVE ROTATIONS. I. Ruder, H. (Erlangen-Nuernberg Univ., Erlangen, Ger.). Z. Naturforsch.; 28a: No. 2, 206-215(Feb 1973). (In German).

Basic in the treatment of collective rotations in the definition of a body-fixed coordinate system. A kinematical method is derived to obtain the Hamiltonian of an n-body problem for a given definition of the body-fixed system. From this exact Hamiltonian, a consequent perturbation expansion in terms of the total angular momentum leads to two exact expressions: one for the collective rotational energy, which has to be added to the ground-state energy in this order of perturbation, and a second one for the effective inertia tensor in the ground state. The discussion of these results leads to two criteria on how to define the best body-fixed coordinate system, namely a differential equation and a variational principle. The equivalence of both is shown. (2 figures) (auth)

20220 HARTREE–FOCK CALCULATIONS FOR NUCLEI IN f7/2 SHELL. Boschan, P. (Lorand Eotvos Univ., Budapest). Acta Phys. Acad. Sci. Hung.; 36: No. 1, 57-67(1974).

With an effective nucleon–nucleon interaction used the Hartree–Fock method is applied for deformed nuclei. No rearrangement term is taken into account which results in a serious lack of binding energy. On the other hand good r.m.s. radii and correct

deformations are obtained. In the region covered by the investigations the Hartree–Fock gap was found to be small. (auth)

20221 MICROSCOPIC THEORY OF INELASTIC SCATTERING BY DEFORMED NUCLEI. Sevgen, A. New Haven, CT; Yale Univ. (1971). 334p. University Microfilms Order No. 74-8385.

Thesis (Ph. D.).

A "microscopic" theory of inelastic scattering of nucleons from deformed nuclei is formulated and applied to the study of the splitting of the s-wave neutron strength function and the properties of the optical-model potential (OMP). Results are compared with the phenomenological analyses of experimental data. The formalism is also extended to study scattering from those spherical nuclei which have excited deformed levels. The derivative relation between the elastic and inelastic real form factors, as suggested by the phenomenological analysis, is shown to hold between microscopic form factors. Attention is drawn to the existence of a similar-channels effect, which results in correlations in the decay amplitudes of the compound states to similar channels. Consequences of this effect are the following: phenomenological coupled-channel calculations involve a channel-coupling (deformed) imaginary term in the OMP at low energies even when all the strongly coupled-channels are explicitly taken into account; and the energy averaged S-matrix element $\langle S_{c_1c_2}(E)\rangle$, $(c_1 \neq c_2)$, does not vanish (contrary to the usual statistical assumptions); if all other effects (such as doorway, direct-channel coupling, resonance and threshold effects) can be neglected, then the decays from compound levels to similar channels c_1, c_2 exhibit "correlated" fluctuations as a function of the energy of the decay nucleon. (Diss. Abstr. Int., B)

20222 THEORETICAL NUCLEAR PHYSICS. Volume I. Nuclear Structure. deShalit, A.; Feshbach, H. New York; John Wiley and Sons, Inc. (1974). 1000p. $27.50.

The aim of this work is to describe the fundamental principles underlying the present understanding of nuclear structure and interactions. In many ways the generalized shell model can be considered as the central subject of this volume. The emphasis is on the principles involved. Chapters have the following titles: Nuclear physics — introductory review; The nucleus as a Fermi gas; The properties of nuclear matter; Independent-particle models for finite nuclei; The nuclear shell model; Rotational states in deformed nuclei and other collective modes; Multinucleon systems; Electromagnetic transitions; and The weak interaction. (RWR)

20223 THREE-BODY MODEL OF DIRECT NUCLEAR REACTIONS. Young, S. K. W. College Park, MD; Univ. of Maryland (1973). 243p. University Microfilms Order No. 74-274.

Thesis (Ph. D.).

The validity of the distorted-wave treatment of three-body effects in direct nucleon reactions at low and medium energies was investigated, in particular for elastic scattering and breakup for a solvable (n,n,^{3}He) quasi-three-particle system. In both cases it works quite well. The three-body approach to elastic scattering via a generalized three-body optical model potential reveals the ambiguities in the definition of the optical potential, and the freedom of choice can be utilized to get potentials which when calculated iteratively are rapidly convergent. An optical potential is not necessarily calculable via iteration, and the convergence is not always rapid; however the first-order optical potential is a very good approximation at low and medium energies regardless of how the iterated optical potential series converges. The possibility of systematically writing down the optical potential series for the N-body problem is suggested. In the breakup studies, the Distorted Wave Impulse Approximation (DWIA) is derived from the Faddeev equations and compared with conventional reaction theories built on a three-body framework. These latter approaches suffer from the serious drawback of having to treat the three-body final states approximately. Although the DWIA can be shown to be the best approximation short of solving the three-body integral equations, its adequacy can be questioned. (RWR)

20224 BOSON EXPANSION TECHNIQUES IN THE DESCRIPTION OF NUCLEAR COLLECTIVE MOTION. Braunschweig, D. Austin, TX; Univ. of Texas (1973). 134p. University Microfilms Order No. 74-5199.

Thesis (Ph. D.).

The boson expansion method is introduced as a microscopic technique to describe low-lying states in even–even nuclei. The formalism which is needed to perform the actual calculations is presented in detail. Contributions arising from the sixth-order collective Hamiltonian are included, and also provision is made to take into account the effect of noncollective branches by using a closure type of approach. The formalism is then applied to the study of ^{148,150,152,154}Sm. The transition from spherical nuclei (^{148}Sm) to deformed nuclei (^{154}Sm) is very well described without change of the strength of any of the residual interactions included. The calculations effectively depend on only one free parameter, the quadrupole particle–hole strength. It is also shown that the inclusion of coupling to noncollective branches is capable of lowering band heads of excited bands. The situation with respect to quadrupole moments and electromagnetic transition strengths is very good; the wave functions obtained give a good description of the low-lying states. Finally, a listing of the computer code BOSEXP, used to perform the numerical calculations, is given; a detailed explanation of the code as well as its testing devices are also included. (RWR)

20225 ISOSPIN CONSERVATION IN DIRECT NUCLEAR REACTIONS. Cotanch, S. R. Tallahassee; Florida State Univ. (1973). 192p. University Microfilms Order No. 74-6718.

Thesis (Ph. D.).

The conventional direct reaction theory, the distorted wave Born approximation (DWBA), is examined and found to be limited. In particular, this theory neglects most isospin effects and does not include the charge exchange channel when describing the general reaction A(a,b)B. A generalization is made in which the distorted waves, distorting potentials, and bound state form factors are considered to be functions of isospin. The formalism is developed in both the coupled (isospin) and uncoupled (neutron–proton) representations. This approach explicitly incorporates the charge exchange channel into the transition amplitude for the general direct reaction A(a,b)B. The theory is thereby extended to include multistep processes which involve charge exchange reactions connecting different members of the same isospin multiplet. Such charge exchange reactions are referred to as quasi-elastic. A model involving the Lane operator is introduced to describe both elastic and quasi-elastic scattering and a prescription for deducing model parameters which conserve isospin is offered. A set of generalized Lane equations is derived and this model interaction is employed in the description of the reactions ^{55}Mn(p,p)^{55}Mn and ^{55}Mn(p,n)^{55}Fe. Good agreement with experiment is achieved. The form factor for single-nucleon-transfer reactions and its relation to the bound state is treated in detail. An exact equation for the form factor is developed and three different models are considered. Applications of the isospin-dependent formalism are made in the areas of inelastic scattering and rearrangement phenomena with special emphasis upon single-nucleon transfer. A computer program based on this theory was developed for single-nucleon transfer. The long-standing spectroscopic problem involving the reactions ^{9}Be(^{3}He,d)^{10}B and ^{9}Be(d,n)^{10}B is now removed. Numerical applications are also presented for the reactions ^{19}F(d,^{3}He)^{18}O and ^{19}F(d,t)^{18}F, for which conventional theory is unable to explain the ratios of observed cross sections. Only by utilizing form factors generated from a microscopic analysis can a consistent description be attained. (RWR)

20226 NEUTRINO EMISSION AND PION CONDENSATION IN DENSE MATTER. Part I. Neutrino Pair Emission in Dense Matter: A Many Body Approach. Part II. Pion Condensation in Nuclear and Neutron Star Matter. Flowers, E. G. Jr. Urbana, IL; University of Illinois (1973). 142p. University Microfilms No. 74-12,016.

Thesis (Ph. D.).

The description of neutrino pair emission in dense matter is formulated in terms of the correlation functions of the background matter, and it is considered in detail, at densities and temperatures expected for neutron stars, the neutrino pair bremsstrahlung emission from electrons in a static lattice and the one phonon corrections to this process. The one phonon corrections are important for temperatures greater than the Debye temperature of the lattice and become as large as the static lattice contributions near the melting temperature of the lattice. However, when the one phonon contributions are of most importance the plasma neutrino process is usually the dominant energy loss mechanism. The decay of multiphonon states into neutrinos is also considered and this process is found to be negligible for acoustic phonons due to phase space restrictions. At high densities ($\rho \sim 10^{14}$g/cc) the role played by electrons scattering from degenerate neutrons and protons in the emission of neutrinos is considered. These processes can be important if either the neutrons or the protons (but not both) are superfluid. The equilibrium thermodynamic conditions obeyed by a pion condensed state of dense neutron or neutron star matter are derived. Then simple model calculations of negative pion condensation that satisfy the equilibrium conditions are carried out. In the simplest of these models (p-wave pion-nucleon interaction alone) it is found that matter is unstable to the formation of a condensed pion mode. This model is made more realistic by including other forces: s-wave pion-nucleon interactions pi-pi interactions, and phenomenological form factors in these interactions. These modifications have little influence on the stability of the system. Finally, effects of repulsive nuclear forces on pion condensation are con-

sidered in a simple model, in which only a simplified repulsive zero range nucleon-nucleon interaction proportional to $\underset{\sim}{\sigma}\cdot\underset{\sim}{\sigma}'\ \underset{\sim}{\tau}\cdot\underset{\sim}{\tau}'$ is retained. The density for the pion threshold is very sensitive to the strength of this force. This model of the nuclear force greatly reduces the instability of the system, although it is too crude to restore stability completely. It also indicates the important role nuclear forces play in a correct description of the pion condensed phase. (Diss. Abstr. Int., B)

20227 EXACT FINITE RANGE DWBA CALCULATIONS FOR HEAVY ION TRANSFER REACTION. Low, K. S. Austin, TX; Univ. of Texas (1973). 86p. University Microfilms Order No. 74-5278.

Thesis (Ph. D.).

In order to analyze a heavy-ion transfer reaction, an exact calculation of the finite-range distorted-wave Born-approximation transition amplitude is needed. This involves the manyfold summation of six-dimensional integrals and thus becomes very time-consuming in general. A new technique which enables this type of calculation to be carried out rather fast is introduced. A brief description is given about the recently completed computer program using this new technique and its application to analyze the proton-transfer reactions $^{208}Pb(^{14}O,^{15}N)^{209}Bi$ and $^{88}Sr(^{14}O,^{15}N)^{89}Y$. Results of the calculations fit experimental data fairly well, this outcome showing that exact finite-range calculations can be a useful tool for nuclear spectroscopy. (Diss. Abstr. Int., B)

20228 TRANSFER OF ENERGY TO PHOTO-EMULSION ATOM NUCLEUS. Just, L. (Slovenska Akademia Vied, Kosice, Czech.); Andrejkova, G. Acta Phys. Slovaca; 23: No. 3, 181-186(1973).

Certain aspects of collisions between fast particles and atomic nuclei were studied, especially the transfer of energy to the nucleus and its return to the unexcited state. (auth)

20229 SCIENTIFIC PROBLEMS AND PRACTICAL APPLICATIONS OF NUCLEAR PHYSICS. Lang, J.; Sigrist, A. (Edgenoessische Technische Hochschule, Zurich). Schweiz. Bauztg.; 91: No. 34, 803-809(23 Aug 1973). (In German).

An outline of the historical development of nuclear physics is given including a popular introduction of the current interests, achievements and practical applications. (INIS)

20230 STABILITY AND INSTABILITY OF ATOMIC NUCLEI: RADIOACTIVITY. Ursu, I. (Institutul de Fizica Atomica, Bucharest). pp 103-120 of Energia Atomica. Bucharest; Editura Stiintifica (1973). (In Rumanian)

The characteristics of the atomic nuclei are presented together with the radioactivity phenomena and their laws. The main problems presented are: the nucleus mass and charge, the binding energy and the stability of the nucleus, the isotopic composition of the elements, the natural and artifical radioactivity, the radioactive shift laws, the radioactive disintegration law and the activity measuring units. (INIS)

20231 IDENTIFICATION OF COMPLEX GAMMA-SPECTRA OF RADIATIVE NEUTRON CAPTURE BY A LEAST SQUARES METHOD WITH DEAD TIME BEING TAKEN INTO ACCOUNT. Aripov, G.; Tuzelbaev, S. M. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 1, 47-50(1974). (In Russian).

Consideration is given to a method of identifying complex gamma spectra of radiative neutron capture by a method of least squares with dead time of a multichannel analyzer taken into account. Satisfactory results were obtained for a two-component mixture of Fe and S. (SJR)

20232 PION–NUCLEUS INELASTIC SCATTERING. Lee, T. S. H. Pittsburgh; Univ. of Pittsburgh (1973). 123p. University Microfilms Order No. 74-9456.

Thesis (Ph. D.).

Intermediate-energy pion–nucleus inelastic scattering is studied theoretically by means of a momentum-space distorted-wave method. Through use of the lowest-order distorted-wave theory, the basic features of the pion–nucleus inelastic scattering are examined in detail. By comparing the results calculated by using various descriptions of the pion-nucleon off-energy-shell interaction, it is shown that the large-angle pion–nucleus inelastic scattering is sensitive to the pion–nucleon off-shell effect. By comparing the low- and high-partial wave contributions to the pion–nucleus inelastic scattering cross section, it is shown that pion–nucleus scattering is predominantly a surface reaction. The detailed reaction mechanism for pion–nucleus inelastic scattering is then studied by examining the relationship between the shape of nuclear form factor and the differential cross section. The principal result is that a more diffractive pattern in differential cross section generally reflects either a longer-tailed form factor or a form factor peaked at a larger radius. To study the sensitivity of pion–nucleus inelastic scattering to nuclear structure, both the collective rotational model and microscopic Gillet and VinhMau wave functions of the 2^+(4.43 MeV) and 3^-(9.64 MeV) excited states of ^{12}C were used in the calculations and compared. The results were also compared to the available data. (Diss. Abstr. Int., B)

20233 PRODUCTION OF MULTIPARTICLE FINAL STATES BY COHERENT EXCITATION OF PROJECTILES IN NUCLEAR TARGETS. Fishbane, P. M. (State Univ. of New York, Stony Brook); Trefil, J. S. Phys. Rev., D; 9: No. 1, 168-177(1 Jan 1974).

The production of multiparticle final state on nuclear targets via multiple coherent excitation of the projectile is developed. By coherent excitation we mean that class of production models including fragmentation models or diffractive excitation models. It is found that both the rapidity distribution of secondaries in inclusive reactions and the multiplicities can be calculated, and new features of the excitation models are revealed. The calculable quantities are found to depend only weakly on the atomic number of the target; in particular, the single-particle distribution in the target fragmentation region grows roughly as $A^{\frac{1}{3}}$. An amusing possibility of boosting effective beam energy for resonance production by using nuclear targets emerges. (auth)

20234 COHERENT SCATTERING ON DEUTERIUM: FORMULA INCLUDING SPINS. Lesniak, L.; Zalewski, K. (Inst. of Nuclear Physics, Krakow). Acta Phys. Pol.; B5: No. 3, 385-396(1974).

A general formula for coherent scattering on deuterium, including all the complications due to isospin and spin, is derived from Glauber's theory. The advantage of using tensor transition amplitudes instead of the usual amplitudes with two spin projections as indices is stressed. (auth)

20235 PHILLIPS' PLOT WITH SOME NONLOCAL SEPARABLE INTERACTIONS. Lamot, G. H.; Fayard, C.; Elbaz, E. (Univ., Lyon). Nuovo Cim.; 22A: No. 4, 609-618(21 Aug 1974).

The Phillips' plot with different types of nonlocal separable interactions (up to rank 6) was investigated in the $^3S_1-{}^3D_1$ channel. All the P-wave contributions with rank-one interactions were then included. The effect appears to be weak on the triton binding energy but nonnegligible on the doublet scattering length. (auth)

20236 POSSIBLE EXPLANATION OF THE EXPERIMENT OF HIGH ENERGY PHOTON SPLITTING IN THE FIELD OF A NUCLEUS. Dzhilkibaev, R. M.; Kuraev, E. A.; Fadin, V. S.; Khoze, V. A. (Inst. of Nuclear Physics, Novosibirsk, USSR). JETP Lett. (USSR) (Engl. Transl.); 19: No. 1, 47-48(5 Jan 1974).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 19: No. 1, 73-76(5 Jan 1974).

It is shown that the recent DESY experiment in which a photon was produced by interaction of a high-energy photon with a nucleus can be interpreted as the process $\gamma Z \rightarrow Ze^+e^-\gamma$. Expressions are presented for the angular distribution of the photons emitted in this process. (auth)

20237 NUMERICAL CALCULATIONS OF I: CRYSTALLIZATION OF BOSE NEUTRONS AND II: CONDUCTION IN RANDOM SYSTEMS. Cochran, S. G. Ithaca, NY; Cornell Univ. (1974). 212p. University Microfilms Order No. 74-13,753.

Thesis (Ph. D.).

Numerical calculations on two model systems are presented: (I) Monte Carlo variational calculations are performed on models of neutron matter with the aim of determining the density at which crystallization takes place. Two systems with bosons of neutron mass interacting via pairwise Yukawa potentials are considered, and it is found that the model potentials are not strongly repulsive enough to form a solid at any density. Two variational calculations are performed on each model potential and compared along with other methods that have been used to study neutron matter. The first potential represents the repulsive part of the best Reid potential, while the second takes into account a spin-independent attractive part. The models clearly have two defects: the particles are bosons and they interact with simplified forces. However, the results from these models are used to test whether other methods of computation that have been proposed are accurate. These models are used to contrast solidification phenomena in other model systems, for instance, bosons with hard-sphere and Coulomb forces. (II) A numerical model is solved for the purpose of arbitrating between various methods that have been proposed to solve the problem of hopping conduction in amorphous materials. The conductivity of a system of random points connected by conductances that decrease exponentially with separation distance is calculated numerically. The numerical results can be quantitatively understood by using ideas based on percolation theory. It is inferred that this method correctly solves the hopping conduction problem. Thermoelectric power and magnetoresistance in the hopping regime are discussed. (Diss. Abstr. Int., B)

20238 EXTENSION OF BELYAEV–ZELEVINSKI METHOD OF ROTATION AS INTRINSIC NUCLEAR EXCITATION. Gray,

J. W. Binghamton, NY; State Univ. of New York (1973). 201p. University Microfilms Order No. 74-12,776.

Thesis (Ph. D.).

The method of Belyaev and Zelevinski for handling the rotational collective states of deformed nuclei was extended. It is shown how a $[J(J+1)]^2$ term naturally occurs in the energy spectrum of a rotational band for even–even nuclei. This is accomplished by modifying the assumption that Belyaev and Zelevinski imposed on their $|n>$ states. This leads to a definite relationship between the coefficient of the $J(J+1)$ and $[J(J+1)]^2$ terms in the energy spectrum. This technique is applied to a single isolated j level and to an arbitrary level scheme. (Diss. Abstr. Int., B)

20239 QUASIPARTICLE INTERACTION IN NUCLEAR MATTER. Poggioli, R. S. Stony Brook, NY; State Univ. of New York (1974). 100p. University Microfilms Order No. 74-14,001.

Thesis (Ph. D.).

Landau's theory of normal Fermi liquids is outlined, and a microscopic calculation of the quasi-particle interaction for nuclear matter is detailed. In order to take special care of low-momentum states, a model space is introduced. Excluded from the model space, the high-momentum states are absorbed into the model interaction. An examination of Brueckner–Bethe theory leads to the choice of a truncated G matrix as a good approximation for this model interaction. A simple perturbative approach is attempted within the model space. The quasi-particle interaction is calculated to second order in the model interaction. The values obtained for the Landau parameters are consistent with experimental results. The quasi-particle pole strength is also evaluated and found to be much smaller than previously estimated. (Diss. Abstr. Int., B)

20240 MULTI-STEP REACTIONS OF PARTICLES ON NUCLEI AT HIGH ENERGY. Bochmann, G. V. Montreal; McGill Univ. (1971). 114p.

Thesis.

A coupled channel optical model is used to investigate the importance of multiple production steps for coherent and incoherent reactions on nuclei. Analytic expressions for the cross section are given in the low and infinite energy limits. Detailed calculations are done for a coupled $\pi-A_1-A_2$ system. For photo-reactions on nuclei, calculations are presented within the framework of vector dominance, and are compared with experiments of incoherent ρ^0 and π^+ photoproduction and photon–nucleus total cross sections. The question of the validity of vector dominance is discussed. The total neutron cross section on nuclei is calculated and compared with experiment. The possible contribution of intermediate N^* states to the elastic scattering amplitude is also discussed. The effects of correlations in the nuclear wave functions on elastic and inelastic scattering at high energy are described. It is indicated how these results can be used to calculate coherent and incoherent production processes. (auth)

20241 EFFECT OF SHORT-RANGE CORRELATIONS ON COULOMB MATRIX ELEMENTS. McCarthy, R. J.; Walker, G. E. (Indiana Univ., Bloomington). Phys. Rev., C; 9: No. 3, 809-812 (Mar 1974).

Correlated wave functions obtained by solving the Bethe-Goldstone equation with the Hamada-Johnston potential are used to calculate Coulomb matrix elements for use in the nuclear 1p shell. When proper attention is given to the Pauli operator it is that Coulomb matrix elements are not appreciably larger than those obtained using uncorrelated wave functions, in contrast to conclusions reached by previous investigators. (auth)

20242 ANALYSIS OF TWO PHENOMENOLOGICAL DESCRIPTIONS OF GROUND-STATE BANDS IN SPHERICAL AND CLOSED-SHELL NUCLEI. Gorfinkiel, J. I. (Universidad de Buenos Aires); Mariscotti, M. A. J.; Pomar, C. Phys. Rev., C; 9: No. 4, 1243-1252(Apr 1974).

Recent results concerning the application of the centrifugal stretching and the variable-moment-of-inertia (VMI) models to the description of ground-state bands in near-harmonic nuclei are discussed. As an extension of previous work dealing with deformed nuclei, the solutions of the centrifugal-stretching model which apply to near-harmonic and closed-shell nuclei are obtained and compared with those of the VMI model. In both cases there is more than one solution which applies to these nuclei. The irregularities observed in a plot of energy ratios E_1/E_2 vs E_4/E_2 for $E_4/E_2 \sim 2$ are not well reproduced by either description, but the predictions of the VMI model appear to correspond to the maximum and minimum values found experimentally. In the Te isotopes the transition between these limits takes place in a smooth way as the number of neutrons increases. The data of magic nuclei are accurately reproduced only by the VMI model. The ratios E_4/E_2 for these nuclei are found to be correlated with the extra binding due to closed shells. (4 figures, 2 tables) (auth)

20243 LEVEL–LEVEL CORRELATIONS IN HAUSER–FESHBACH THEORY AND MOLDAUER'S SUM RULE FOR RESONANCE REACTIONS. Weidenmueller, H. A. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Phys. Rev., C; 9: No. 3, 1202-1204 (Mar 1974).

It is shown that Moldauer's sum rule is equivalent to analyticity and unitarity of the S matrix. Inconsistencies derived from the sum rule with the help of some approximation thus indicate that the approximation violates unitarity. It is also shown that a derivation of the Hauser–Feshbach formula beyond the regime of small absorption in all channels is possible only in the framework of a dynamical model for the compound nucleus. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 18712, 18723, 18863, 18929, and 18932.

20244 (AD-767439) SAM-CE: A THREE-DIMENSIONAL MONTE CARLO CODE FOR SOLUTION OF THE FORWARD NEUTRON AND FORWARD AND ADJOINT GAMMA-RAY TRANSPORT EQUATIONS: REVISION B. Final Report. Cohen, M. O.; Guber, W.; Troubetzkoy, E.; Lichtenstein, H.; Steinberg, H. (Mathematical Applications Group, Inc., Elmsford, N. Y. (USA)). 3 Aug 1973. Contract DNA-001-73-C-0016. 248p. (MR-7021(Rev.B); DNA-2830-F-B). NTIS $5.75.

The SAM-CE system is a FORTRAN Monte Carlo computer code designed to solve the time-dependent neutron and gamma-ray transport equations in complex three-dimensional geometries. SAM-CE is applicable for forward neutron calculations and for forward as well as adjoint primary gamma-ray calculations. In addition, SAM-CE is applicable for the gamma-ray stage of the coupled neutron–secondary gamma-ray problem, which also may be solved in either the forward or the adjoint mode. Time-dependent fluxes, and flux functionals such as dose, heating, count rates, etc., are calculated as function of energy, time, and position. Multiple scoring regions are permitted; these may be either finite volume regions or point detectors or both. Other scores of interest, e.g., collision and adsorption densities, etc., are also made. A special feature of SAM-CE is its use of the "combinatorial geometry" technique, which affords the user geometric capabilities exceeding those available with other commonly used geometric packages. (GRA)

20245 (ORNL-4984) CONVERGENCE OF THE DISCRETE ORDINATES METHOD FOR THE TRANSPORT EQUATION. Anselone, P. M.; Gibbs, A. G. (Oak Ridge National Lab., Tenn. (USA)). Jul 1974. Contract W-7405-eng-26. 31p. Dep. NTIS $4.00.

The transport equation for the distribution of neutrons or radiation is an integro-differential equation of some complexity. The discrete ordinates method of approximate solution, which is based on numerical integration, has been used for a number of years to obtain satisfactory results. A complete convergence of error analysis is available, however, only in some rather idealized cases. The various contributions to the literature on the convergence question are surveyed from an abstract and unifying point of view. In the process, methods of analysis are developed which are applicable to very general transport problems. (auth)

20246 STOPPING CROSS SECTIONS AND BACKSCATTERING FACTORS FOR ^{4}He IONS IN MATTER. $Z = 1-92$, $E(^4He) = 400-4000$ keV. Ziegler, J. F.; Chu, W. K. (IBM-Research, Yorktown Heights, NY). At. Data Nucl. Data Tables; 13: No. 5, 463-489 (May 1974).

A table is presented of semiempirical values of stopping cross sections [expressed in eV/(atom/cm^2)] for ^{4}He ions in every element ($1 \leq Z \leq 92$) for ion energies from 400 to 4000 keV. The semiempirical results were fitted with polynomial expansions whose coefficients are also tabulated. The stopping cross sections provide parameters for the interpretation of backscattering experiments, for example, factors for converting backscattering-peak widths to areal density (atoms/cm^2). The semiempirical results are based on recent experimental measurements and on theoretical values calculated in the Lindhard–Winther formalism with Hartree–Fock–Slater elemental wave functions. Comments are included on combining the specific energy loss tables for compound backscattering analysis by using Bragg's Rule, and also on the effects on backscattering of target tilt and of the finite thicknesses of targets. (7 figures, 8 tables) (auth)

20247 SCHEMATIZED ISODOSE PICTURES FOR THE CALCULATION OF PENDULUM IRRADIATION IN DEEP ^{60}Co THERAPY. P. 1. Monoaxial Pendulum Irradiation. Roedel, K. (Giessen Univ. (F. R. Germany). Zentrum fuer Radiologie). Strahlentherapie; 147: No. 1, 24-30(Jan 1974). (In German).

6 figs.; 9 refs.

A method for the compensation of the phanton-depth dependence of film dosimetry is described. Systematic investigations using this method led to assessment formulas for the dose extremes in the absolute maximum in comparison to the dose in the axis as well as the isodose level under monaxial pendulum movement. Schematized isodose pictures derived from these formulas allow quick individual planning as well as an optimization of standardized irradiation plans. (GE)

20248 SCHEMATIZED ISODOSE PICTURES FOR THE CALCULATION OF PENDULUM IRRADIATION IN DEEP ^{60}Co THERAPY. P. 2. Standardized Pendulum Irradiation of a Main Bronchus. Roedel, K. (Giessen Univ. (F. R. Germany). Zentrum fuer Radiologie). Strahlentherapie; 147: No. 1, 31-34(Jan 1974). (In German).

4 figs.; 3 refs.

The method for the calculation of monoaxial pendulum irradiation plans, explained in a previous paper, is demonstrated by the example of the pendulum irradiation of a main bronchus. The present paper specifies the anatomical situation, demonstrates the calculation by a schematized isodose picture and, finally, the definitive dose distribution. The method is completed by considering the influence of tissue inhomogenities on the form and size of the isodoses, as well as on the diagram for the determination of the absolute dose in the pendulum axis. (GE)

Radiation Protection Standards

Refer also to abstract 20531.

20249 ICRU RECOMMENDATIONS CONCERNING THE NOTIONS RBE, QUALITY FACTOR, AND EQUIVALENT DOSE. Wambersie, A. (International Commission of Radiological Protection, Sutton, Eng.). J. Belge Radiol.; 57: No. 1, 29-41 (1974). (In French).

Some concepts and quantities to be used in Radiation Protection are discussed: quality factor Q, dose equivalent H (ICRU, Radiation Quantities and Units, Report 19, 1971). The concepts of "quality factor" and of "relative biological effectiveness" (RBE) are compared. According to the ICRP definition (1963), an RBE value has to be refered to a specific biological effect. Some examples are presented, showing how the RBE of a given "radiation quality" varies with different factors such as the biological system and criterion, the physiological conditions (oxygenation, . . .), the "time factor" (dose rate, fractionation) etc. Therefore, the concepts of quality factor (Q) and dose equivalent (H) have been introduced. The quality factors are conventional and fixed values and their use (as well as the use of the dose equivalent and of the rem) should be limited to the radiation protection applications, when the dose are equal or smaller than the maximal permissible doses (MPD). (auth)

20250 APPARATUS FOR PLASMA SPECTROSCOPIC INVESTIGATION IN THE VISIBLE SPECTRUM. Carretta, U.; Tartari, U. (CNR-EURATOM, Milan). Lett. Nuovo Cim.; 10: No. 14, 615-620(3 Aug 1974).

An apparatus is described for the measurement of ion temperature and axial energy employing a Fabry–Perot scanning method whose reliability against drifts has been greatly improved by means of a relatively simple laser control system. The drift neutralization consists in a time delay, introduced in the measurement, equal to the time delay with which the peak of the plasma line appears due to any spurious variation of the spacing between the Fabry–Perot mirrors. (MOW)

20251 MEDICAL X-RAY EQUIPMENT UP TO 300 kV. Radiation Protection Rules for Installation. DIN 6812. Fortschr. Geb. Roentgenstr. Nuklearmed.; 120: No. 5, 626-638(May 1974). (In German).

9 tabs.; 6 figs.

A tentative standard is presented with the following content: validity, maximum permissible body dose, general regulations for the planning of X-ray installations, operational data and mode, calculation of shielding layers, additional constructional radiation protection measures characterization, radiation protection documents, attenuation diagrams and tables, compilation of calculation methods for the determination of shielding layers against effective and parasitic radiation and calculation examples. (GE)

Radiation Source Calibration and Standardization

Refer also to abstracts 18726 and 18824.

Shielding Calculations and Experiments

Refer also to abstracts 19989, 20006, and 20475.

20252 PASSAGE OF RADIATIONS THROUGH JOINTS IN MODULAR CONCRETE SHIELDING. Dubrovskii, V. B.; Ivanov,

V. N. Sov. J. At. Energy (Engl. Transl.); 34: No. 1, 47(Jan 1973).

Translated from At. Energ. (USSR); 34: No. 1, 36-37(Jan 1973). This is a summary of paper No. 643/6964 with full copy held at TIC.

Results of measurements of neutron flux and γ-radiation dose rate on the far side of shielding made up of sectional concrete blocks, with measurements taken at the outer surface of the blocks. The dependence of the far-side radiation field on the length of the joint, at constant height and width, and also on the height of the step in a plane joint, formed in vertical shear displacement of adjacent blocks, was investigated. The results obtained are compared to measurements taken under similar conditions on monolithic shielding made of the same concrete. (MHR)

20253 EXPERIMENTAL INVESTIGATIONS OF MODULAR OR SECTIONAL CONCRETE BIOLOGICAL SHIELDING. Dubrovskii, V. B.; Ivanov, V. N.; Martem'yanov, I. N. Sov. J. At. Energy (Engl. Transl.); 34: No. 1, 46-47(Jan 1973).

Translated from At. Energ. (USSR); 34: No. 1, 36(Jan 1973). This is a summary of paper No. 642/6925 with full copy held at TIC.

Shielding characteristics of modular concrete structures consisting of blocks fabricated to different tolerances and to be laid in place dry are gone into. Experimental investigations were carried out in the caster-mounted tote box servicing a recess in the IR-100 reactor, and using a shielded halogen β-counter (to detect the γ-radiation), as well as aluminum threshold indicators, indium resonance indicators, and URSa-7 scintillation detectors for neutron detection. Modular concrete blocks were sized 100 × 200 × 400 mm, and the thickness of the shields investigated was 800, 1200, and 1600 mm. It was found that the shape and dimensions of the planar horizontal joints which have a decisive effect on the shielding effectiveness of the modular structure depend on the precision to which the modular blocks are fabricated, and that is limited by the band of linear tolerances. (MHR)

20254 EXPERIMENTAL EVIDENCE OF AN EQUILIBRIUM PROPERTY IN GAMMA-RAY ANGULAR SPECTRA PENETRATING BULK SHIELDS. Johnson, D. M.; Woollam, P. B. (Berkeley Nuclear Labs., Eng.). Nucl. Sci. Eng.; 54: 254-262(Jul 1974).

Angular penetration gamma-ray spectra were measured from a ^{60}Co source in point and plane geometries with both homogeneous and heterogeneous combinations of various thicknesses of iron and concrete slabs. The results are presented in the form of angular flux as a function of angle of deviation for particular secondary energies. The pseudoequilibrium behavior, with regard to penetration depth, of the angular spectra from certain source geometries was observed, and methods are suggested as to how this property could be incorporated in a gamma-ray transport code. (auth)

PHYSICS (THEORETICAL)

General

Refer also to abstract 20219.

20255 (LA-5560) EXACT SOLUTION TO PURE BINARY REACTION PROBLEMS. Lee, C. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Feb 1974. Contract W-7405-eng-36. 5p. Dep. NTIS $4.00.

Binary reaction problems occur in various circumstances in chemical kinetics, reaction plasma, stellar evolution, and nucleosynthesis. These processes are governed by equations of the type $n' = B\,n\,n$. Assuming that the tensor B is symmetric and constant in some time interval Δt, we show that the solution to Eq. (1) is $n(t) = [I - A\,(t_0)\,\Delta t]^{-1}\,n(t_0)$, (2) where $n(t_0)$ are the given initial densities and the matrix $A(t)$ is given by $A(t) = B\,n(t)$. Evaluation of the norm conditions for known approximate solutions to Eq. (1) indicates that the proposed solution method will always be as fast as, or faster than, the first-order methods. (auth)

20256 SOLUTION OF SCHROEDINGER EQUATION FOR THE TIETZ OSCILLATOR. Sazonov, I. E.; Zhirnov, N. I. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 2, 32-37(1974). (In Russian).

Exact solutions of the Schroedinger are obtained for the oscillatory-rotational (stationary and quasistationary) states of a diatomic molecule which can be described by Tietz potential curves. The convergence of the solutions is proved. (SJR)

20257 NUMERICAL STUDY OF ENERGY-LEVEL CROSSING. Bender, C. M.; Happ, H. J.; Svetitsky, B. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., D; 9: No. 8, 2324-2329(15 Apr 1974).

A rapidly convergent numerical method recently proposed by Graffi and Grecchi was used to study the analytic properties of the eigenvalues $E(\epsilon)$ of the differential equation $[-(d^2/dx^2) + \epsilon|x| + \frac{1}{4}x^2 - E(\epsilon)]\psi(x) = 0$, $\lim_{|x|\to\infty} \psi(x) = 0$. $E(\epsilon)$ was analytically into the complex ϵ plane on a computer, the phenomenon of level crossing, was demonstrated graphically, and it was shown that the crossing points are square-root branch points. (auth)

20258 ALGEBRA OF LEVEL SPLITTING. Louck, J. D. (Los Alamos Scientific Lab., NM). Phys. Rev., A; 9: No. 6, 2273-2281(Jun 1974).

The algebra of level splitting discovered by Biedenharn and Gamba is developed for the case $SU(2) \times SU(2) \supset SU(2)$. This is the physically interesting case to which much of conventional angular momentum theory is addressed. The interrelations of the two approaches are discussed in detail. (auth)

20259 SPLITTING OF A DEGENERATE LEVEL UNDER THE ACTION OF A SYMMETRY-BREAKING HAMILTONIAN. de Vries, E. de; Van Zanten, A. J. (Duke Univ., Durham, NC). J. Phys., A (London); 7: No. 7, 807-817(1 May 1974).

Recently Biedenharn and Gamba (Rev. Bras. Fis.; 2: 319-33 (1972)) described a simple group-theoretical method to calculate the quantitative splitting of a degenerate energy level under the action of a symmetry-breaking hamiltonian. The general proofs for the rules of the method are provided and the group-theoretical background is clarified. The various kinds of multiplicities which can arise and the difficulties which they entail are discussed. (auth)

20260 DERIVATION OF THE HARTREE–FOCK EQUATIONS. III. Introduction of the LCAO FORMALISM. Mayer, I. (Central Research Inst. for Chemistry, Budapest). Acta Phys. Acad. Sci. Hung.; 36: No. 1, 11-17(1974).

Two methods for introducing the LCAO formalism into SCF equations are discussed by using the UHF equations as an example. (auth)

20261 QUASI-RELATIVISTIC BOLTZMANN EQUATION FOR SYSTEMS WITH SHORT-RANGE FORCES. Pavlotskii, I. P.; Shekhovtsova, L. G. (Inst. of Applied Mathematics, Moscow). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 2, 78-82(1974). (In Russian).

Quasi-relativistic systems are those whose description requires that terms on the order of v^2/c^2 be taken into account, where v is the velocity of the particle and c is the velocity of light. Consideration is given to systems of neutral particles with interaction forces different from zero at such small distances that the lag time of the interaction can be neglected. On the basis of a Lagrangian function known in a quasi-relativistic approximation, equations are derived for correlation functions, from which, in turn, by the method of Bogolyubov the quasi-relativistic analog of the Boltzmann equation is constructed. (SJR)

20262 SCHROEDINGER EQUATION WITH NON-LOCAL POTENTIAL. I. The Resolvent. von der Heydt, N. (Philipps-Univ., Marburg, Ger.). Ann. Phys. (Leipzig); 29: No. 4, 309-324 (1973). (In German).

For a wide class of nonlocal potentials the Schrödinger integro-differential equations for the radial waves may be reduced to integral equations containing L^2-kernels. Therefore a number of analytic and functional-analytic properties of the resolvent of the radial wave equation may be deduced by means of the Fredholm method. Thence, the completeness of the physical radial wave functions, among other things, is proved by a known method. The positive-energy bound states occurring with nonlocal potentials are interpreted as resonances of vanishing width. The non-imaginary "resonance poles" of the resolvent are considered in a strip $0 > \mathrm{Im}\,k > -\alpha$ of the complex-plane $1/\alpha$ being the range of the potential. The structure of the principal parts is specified. (auth)

20263 APPROXIMATE MEASUREMENT IN QUANTUM MECHANICS. I. Fehrs, M. H. (Lafayette Coll., Easton, PA); Shimony, A. Phys. Rev., D; 9: No. 8, 2317-2320(15 Apr 1974).

It is shown that the quantum problem of measurement remains unsolved even when the initial state of the apparatus is described by a statistical operator and when the results of measurement have a small probability of being erroneous. A realistic treatment of the measurement of observables of microscopic objects (e.g., the position or the spin of an electron) by means of observables of macroscopic apparatus (e.g., the position of a spot on a photographic plate) requires the consideration of errors. Measurement procedures of the following type were considered: an initial eigenstate of the object observable leads to a final statistical operator of the object plus apparatus which describes a mixture of "approximate" eigenstates of the apparatus observable. It is proved that each of a large class of initial states leads to a final statistical operator which does not describe any mixture containing even one "approximate" eigenstate of the apparatus observable. (auth)

20264 RELATIVISTIC QUANTUM THEORY. Lifshitz, E. M.; Pitaevskii, L. P. Course of Theoretical Physics, Volume 4, Part 2. Reading, MA; Addison-Wesley/W. A. Benjamin, Inc. (1973). 246p. $12.50.

Translated from the Russian by J. B. Sykes and J. S. Bell.

The treatment covers exact propagators and vertex parts, radiative corrections, asymptotic formulas of quantum electrodynamics, dynamic symmetry hadrons, electrodynamics of hadrons, and weak interactions. (JFP)

20265 QUANTUM PHYSICS. Gasiorowicz, S. New York; John Wiley and Sons, Inc. (1974). 524p. $16.95.

The topics covered include the limits of classical physics, wave packets and the uncertainty relations, the Schroedinger wave equation, eigenfunctions and eigenvalues, one-dimensional potentials, the general structure of wave mechanics, operator methods in quantum mechanics, n-particle systems, angular momentum, the radial equation, the hydrogen atom, the interaction of electrons with the electromagnetic field, operators, matrices, and spin, the addition of angular momenta, time independent perturbation theory, the real hydrogen and the helium atoms. Also covered are the structure of atoms, molecules, molecular structure, the radiation of atoms, selected topics in radiative transitions, collision theory, the absorption of radiation in matter, and elementary particles and their symmetries. (JFP)

20266 FOUNDATIONS OF STOCHASTIC ELECTRODYNAMICS. I. General Formalism and the Free Radiation Field. Santos, E. (Univ., Valladolid, Spain). Nuovo Cim.; 22B: No. 2, 201-214 (11 Aug 1974).

Stochastic electrodynamics is classical electrodynamics with the hypothesis of a random background radiation in the whole space. The probability distributions of the Fourier components of this electromagnetic radiation are assumed Gaussian. Lorentz invariance fixes the spectrum of the radiation except for a constant, measuring its intensity, which is identified with Planck's constant. A formalism is developed to deal with general stochastic problems, associating a Hilbert space with every set of random variables. Then, a mapping is defined of the algebra of continuous functions of the random variables onto the algebra of operators on the Hilbert space. A correspondence is found between probability distributions of the random variables and vectors in the Hilbert space. The case of Gaussian random variables is considered in detail. The formalism is applied to the study of the radiation field when some known amount of radiation is present besides the random background. This closely resembles the usual quantization of the free radiation field, although there are significant differences.

In particular, not all vectors of the Hilbert space represent physical states in the present theory. (auth)

20267 BOUNDS FOR SECOND ORDER PERTURBATION THEORY. Burrows, B. L. (North Staffordshire Polytechnic, Stafford, Eng.). J. Phys., B (London); 7: No. 8, 881-891(1 Jun 1974).

Complementary variational methods for the solution of a general equation are developed. It is shown that these lead to upper and lower bounds for the second order energy of Rayleigh–Schroedinger perturbation theory for both the ground and a general excited state. The theory may also be applied to the time dependent perturbative calculation of dynamic polarizabilities at real frequencies and upper and lower bounds are derived for any nonresonant value of the frequency. Illustrative calculations are presented. (auth)

20268 CHARACTERIZATION OF BOUND STATES AND SCATTERING STATES IN QUANTUM MECHANICS. Amrein, W. O.; Georgescu, V. (Univ., Geneva). Helv. Phys. Acta; 46: No. 5, 635-658(1973).

Ruelle's definition of bound states and scattering states in quantum mechanics in terms of the position operator is related to the usually accepted definition of these states in terms of the spectral properties of the Hamiltonian H, viz. the states belonging to the point spectrum or the continuous spectrum of H. The equivalence of the two ways of defining these states is established for a large class of n-body Hamiltonians ($n < \infty$) including practically all Schroedinger Hamiltonians of physical interest as well as Dirac Hamiltonians. (auth)

Quantum Field Theories

Refer also to abstracts 19857, 19908, 19951, and 20312.

20269 (DESY–74/8) THE SIGNIFICANCE OF CONFORMAL INVERSION IN QUANTUM FIELD THEORY. Koller, K. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Mar 1974. 28p. INIS.

19 refs. With abstract.

The 2-point functions of Euclidean conformal invariant quantum field theory are looked at as intertwining kernels of the conformal group. In this analysis a fundamental role is played by a two-element group W, whose nonidentity element $R = R' \times I$ consists of the conformal inversion R' multiplied by a space-time reflection I. The propagators of conformal invariant quantum field theory are determined by the requirement of R-covariance. The importance of the R-inversion in the theory of Zeta-functions is mentioned. (orig.)

20270 (JINR–E2-7936) TRANSLATION INVARIANT QUANTUM FIELD THEORY WITH DE-SITTER MOMENTUM SPACE OFF THE MASS SHELL. Donkov, A. D.; Kadyshevskii, V. G.; Mateev, M. D.; Mir-Kasimov, R. H. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 28p. (CONF-740713–9). Dep. NTIS (US Sales Only) $4.50.

From 17th international conference on high-energy physics; London, UK (1 Jul 1974).

In the framework of Bogolubov's axiomatic approach problems connected with the extension of the scattering matrix off the mass shell are considered. A specific point for the standard extension procedure is the assumption that the four dimensional space of virtual momenta in which the extended objects (fields, currents, S-matrix coefficient functions, etc.) are defined is flat Minkowski space. However, such a choice of the geometry of the virtual momentum space does not follow from the basic axioms of the theory and in fact is an independent postulate. In this opinion the pseudoeuclidean momentum space is not adequate for the description of the phenomena at high energies (short distances). It is supposed that the use of Minkowdki p-space is actually responsible for the known difficulties of the local quantum field theory connected with the problem of multiplying of distributions with coinciding singularities on the light cone. As an alternative proposed to use in the extension of the S-matrix a 4-momentum space of constant curvature (De-Sitter space) with curvature radius $1/l_0$, where l_0 is a fundamental length. The interaction laws of the elementary particles at large momenta are completely different in the new scheme. The off-mass-shell S-matrix extension in the spirit of De-Sitter p-space geometry is consistent with the requirements of Poincaré invariance, unitarity, spectrality, completeness of the system of asymptotic states. With the help of a Fourier transformation in De-Sitter momentum space a new configuration ξ -space is introduced, whose geometry for small distances $\lesssim l_0$ is essentially different from the pseudoeuclidean one. The causality condition which is direct generalization of Bogolubov's causality condition, going to it in the limit $l_0 \to 0$, is formulated in terms of this ξ -space. It is demonstrated that in the developed theory the problem of distribution products loses its acuteness. In particular the commutation functions and propagators in the new scheme are usual (not generalized) functions and there is no arbitrariness in any of their powers and products. (auth)

20271 SELF-ADJOINTNESS OF THE LORENTZ GENERATOR FOR $(:\varphi^4:)_{1+1}$. Gidas, B. (Univ. of Michigan, Ann Arbor). J. Math. Phys. (N. Y.); 15: No. 6, 867-869(Jun 1974).

An alternative proof to that provided by Jaffe and Cannon of the self-adjointness of the local Lorentz generator for the $(:\varphi^4:)_{1+1}$ quantum field theory is given. The proof avoids the use of second-order estimates and a singular perturbation theory. (auth)

20272 PROPERTIES OF THE $(:\varphi^4:)_{1+1}$ INTERACTION HAMILTONIAN. Gidas, B. (Univ. of Michigan, Ann Arbor). J. Math. Phys. (N. Y.); 15: No. 6, 861-866(Jun 1974).

Using a convergent expansion of the resolvent of the Hamiltonian $H = H_0 + \lambda V$, $V = \int dx \times (x) : \varphi^4 : (x)$, $g(x) \in C_0^\infty$, $g(x) \geq 0$; simple proof is given of the self-adjointness of the Hamiltonian and the volume independent lower bound of the vacuum energy per unit volume. Also, some coupling constant analyticity properties of the Hamiltonian are obtained, and the limit $(H_0 + \lambda v|z)^{-1} \to (H_0 - z)^{-1}$ $z \in \rho(H_0)$ in norm as $|\lambda| \to 0$ uniformly in $\{\lambda : |\arg\lambda| < \pi\}$. (auth)

20273 CAUSALITY AND NONLOCALIZABLE FIELDS. Constantinescu, F. (Univ. of Frankfurt am Main); Taylor, J. G. J. Math. Phys. (N. Y.); 15: No. 6, 824-830(Jun 1974).

A model-independent and Lorentz invariant prescription is given for the manner in which a nonlocalizable quantum field extends outside the light cone, in particular specifying the order of this extension. It is shown how the definition applies to several examples, including the nonlocalizable free field and certain functions of the massive free field; nonlocalizable functions of the massless free field presents a difficulty which was not yet resolved. (auth)

20274 VECTOR-MESON DOMINANCE IN FIELD-THEORETIC MODELS. Datta, A.; Ghose, P. (Visva-Bharti Univ., Santiniketan, India). Phys. Rev., D; 9: No. 8, 2465-2470(15 Apr 1974).

Several field-theoretic models with leptons were considered with a view to study whether they really describe vector-meson dominance (VMD). A functional technique for rapidly summing chains of propagators was used, so that the results are valid to all orders in perturbation theory. It is found that none of these models describes exact VMD. However, effective and also explicit VMD can be accommodated in them under certain reasonable approximations. (auth)

20275 APPROXIMATE MEASUREMENT IN QUANTUM MECHANICS. II. Shimony, A. (Laboratoire de Physique, Orsay, France). Phys. Rev., D; 9: No. 8 2321-2323(15 Apr 1974).

An approximate measurement procedure of the following type is considered: An initial eigenstate of the object observable leads to a final statistical operator of the object plus apparatus describing a mixture of exact eigenstates of the apparatus observable; almost all the statistical weight of the mixture is assigned to eigenstates associated with one eigenvalue of the apparatus observable, which is uniquely determined by the initial value of the object observable. It is proved that each of a large class of initial states of the object leads to a final statistical operator which does not describe any mixture of exact eigenstates of the apparatus observable. The analysis also yields a proof of a theorem on measurement stated by Fine. (auth)

20276 LIE SYMMETRY GROUPS FOR CLASSICAL FIELDS. Oliveira, C. G. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Can. J. Phys.; 52: No. 7, 639-647(1 Apr 1974).

The symmetry Lie groups associated with isolated fields are derived from an analogy with the corresponding problem for particle dynamics. These symmetry groups may contain point to point transformations which depend on the values assumed by the field function at the point which is being transformed. Some examples are given, and some of the possible implications of the present method are discussed. (auth)

20277 EXAMPLE OF INTERACTING CLASSICAL VECTOR FIELDS HAVING A STATIC SOLUTION FOR THE WAVE EQUATIONS. Ferretti, B.; Velo, G. (Univ., Bologna). Lett. Nuovo Cim.; 10: No. 11, 451-454(13 Jul 1974).

The case of only two interacting vector fields is considered, and static spherically-symmetric solutions of the wave equations are examined as an example of interacting classical vector fields having a static solution for the wave equation. (JFP)

20278 SPEED OF LIGHT AND THE NEW METER. Bay, Z.; White, J. A. (American Univ., Washington, DC). Acta Phys. Acad. Sci. Hung.; 36: No. 1, 91-106(1974).

New developments in the measurement of optical frequencies and the speed of light offer now the exciting possibility of creating

a unified time-length measurement system and a highly accurate new meter. (auth)

20279 PURELY GEOMETRICAL INTRODUCTION OF SPINORS IN SPECIAL RELATIVITY BY MEANS OF CONFORMAL MAPPINGS ON THE CELESTIAL SPHERE. Ebner, D. W. (Univ., Konstanz, Ger.). Ann. Phys. (Leipzig); 31: No. 3-4, 206-210 (1973).

Spinors are introduced using geometrical concepts only, such that no knowledge in representation theory is presupposed. The essential part is the purely geometrical proof of the conformity of the mapping of the celestial sphere onto itself induced by spinors. (auth)

20280 GENERALIZATION OF THE GOVERNING PRINCIPLE OF DISSIPATIVE PROCESSES TO COMPLEX SCALAR FIELDS. Gyarmati, I. (Univ., Godollo, Hungary). Ann. Phys. (Leipzig); 31: No. 1, 18-32(1974).

The genuine variational principle of macroscopic dissipative continua is generalized to complex scalar fields in the universal form of Gaussian type. The generalization makes it possible to extend the validity of the principle to the ψ field of the nonrelativistic Schroedinger equation, and to certain types of nonlinear problems. Following Morse's and Feshbach's sequence of thoughtful ideas in reverse direction the fundamentals of an "abstract" transport theory, isomorphic with one-particle quantum theory, are developed and the possibility of interpreting the quantum theory by classical models is discussed. On the basis of new arguments, the impossibility of interpreting quantum mechanics in terms of classical transport theories (hydrodynamical model, diffusional and stochastic models) is established. (auth)

20281 ZACHARIASEN-THIRRING MODEL WITH ARBITRARY SPIN. Kwasniewski, A. K. (Univ., Wroclaw). Bull. Acad. Pol. Sci., Ser. Sci., Math., Astron. Phys.; 22: No. 3, 333-338(1974).

The Lagrange formulation of the Zachariasen model proposed by Thirring is generalized to the case of a virtually exchanged particle with arbitrary spin. The scattering amplitude is calculated and possible applications are mentioned. (auth)

20282 DYNAMICAL PROBLEM FOR A RIGID BODY IN SPECIAL RELATIVITY. Kafadar, C. B. (Princeton Univ., NJ). Ann. Phys. (Leipzig); 29: No. 4, 325-340(1973).

The dynamical problem for a continuous body constrained to undergo only plane Born motions is solved in special relativity. (auth)

20283 THEORY OF RESTRICTED RELATIVITY, INDEPENDENT OF A POSTULATE ON THE VELOCITY OF LIGHT. di Jorio, M. (Univ. Pisa, Italy). Nuovo Cim., 22B: No. 1, 70-78(11 Jul 1974).

Supposing the wave equation to be invariant when passing from one reference frame to another, the conditions of invariance and the connection between the measures of the same phenomenon in the two reference frames are found. If the transformation is linear and of axial type, it is proven that the constant of the wave equation is the same in the two reference frames: if this constant is equal to c, it is found that the equations of transformation become those of Lorentz. (auth)

20284 TACHYON SINGULARITY: A SPACELIKE COUNTERPART OF THE SCHWARZSCHILD BLACK HOLE. Gott, J. R. III. (California Inst. of Tech., Pasadena). Nuovo Cim., 22B: No. 1, 49-69(11 Jul 1974).

A Schwarzschild-like metric is presented for the region around a singularity associated with a spacelike world-line (tachyon singularity). Kruskal-type extensions of the metric are provided. The form of the metric suggests a qualitative explanation of tachyon motion ($v > c$) that does not involve transport of energy or information at speeds greater than the velocity of light. The extended metrics show both normal and time-reversed gravitational Cherenkov cones of high space curvature. The solutions correspond to half-advanced, half-retarded fields in accord with the Wheeler-Feynman absorber theory. (auth)

20285 PART I. SOME LIMITING RESULTS OF FINITE-TEMPERATURE MANY-BODY THEORY. Part II. Neutrino Reactions on Nuclear Targets. Smith, R. A. Stanford, CA; Stanford University (1973). 159p. University Microfilms Order No. 74-6556.

Thesis (Ph.D.).

Three distinct problems are investigated. The first two are concerned with the application of quantum field theory to equilibrium systems at finite temperature. The third is a calculation of cross sections for neutrion scattering on nuclear targets. The linked-cluster expansion for the finite-temperature Green's function is used as a basis for investigating the cluster expansion of the equation of state. The purpose of this is to study the connection between the microscopic interactions between particles and the macroscopic behavior of the thermodynamic system. In the neighborhood of the classical limit, a diagrammatic expansion is obtained. The classical limit of this series is shown to be the Mayer cluster expansion. A new exact expression is obtained for the quantum mechanical second virial coefficient, and a new set of simple rules is derived for calculating the first quantum correction to the Mayer cluster integrals. Linear response theory is used to calculate the magnetic susceptibility in the classical limit, which reproduces Curie's law. The Green's function method is found to be a useful approach for studying the cluster expansion of the equation of state of thermodynamic systems. The magnetic susceptibility of a system of particles is related to virial coefficients computed in the absence of a field. Both the density and magnetic susceptibility are expanded in terms of certain sums over eigenstates of the many-particle system. The magnetic susceptibility is then expanded in powers of density, whose coefficients are related to certain viral coefficients. The relation of this work to previous work and to experiment is discussed. Calculation of inelastic neutrino scattering cross sections for nuclear targets is discussed motivated by the success of a similar description of electron scattering. The cross sections for quasi-elastic scattering and quasi-free resonance production are computed in a model employing relativistic kinematics and the fully relativistic hadronic weak vertex. For the case of isobar excitation, the cross section is expressed in terms of the helicity amplitudes of the weak current. An analytic expression for the cross section is obtained for a Fermi-gas model and numerical results are presented for regions of interest. (Diss. Abstr. Int., B)

20286 DEMONSTRATION OF NONCAUSALITY FOR THE RARITA-SCHWINGER EQUATION. Hortacsu, M. (Bogazici Univ., Istanbul). Phys. Rev., D; 9: No. 4, 928-930(15 Feb 1974).

Using the Rarita-Schwinger equation for a spin-$\frac{3}{2}$ particle in a constant magnetic field, we explicitly calculate the propagator in 2 + 1 dimensions. From the behavior of the propagstor, it is seen that the propagation is noncausal. (auth)

20287 DEVIATION FROM POWER LAW AT A CALLAN-SYMANZIK EIGENVALUE AND THE NON-NEGLIGIBILITY OF MASS-INSERTION TERMS. Marques, G.; Woo, C. H. (Univ. of Maryland, College Park). Phys. Rev., D; 9: No. 4, 1125-1128(15 Feb 1974).

The mass-insertion term in the Callan-Symanzik equation may not be negligible, even in the deep Euclidean region, because the asymptotic behavior of vertex functions may be different from that of individual dominant graphs. When contributions from different orders of perturbation are related by a constraint, such as the condition that the physical coupling constant is at a nontrivial Callan-Symanzik eigenvalue, cancellations between dominant graphs may occur. This and other circumstances under which vertex functions may fail to satisfy homogeneous Callan-Symanzik equations asymptotically are illustrated with a very simple example, thus emphasizing that the question of asymptotic scale invariance may not be always decided by studying the properties of the β function alone. (auth)

20288 COMMENT ON THE COMPUTATION OF EFFECTIVE POTENTIALS. Salam, A. (International Centre for Theoretical Physics, Trieste, Italy); Strathdee, J. Phys. Rev., D; 9: No. 4, 1129-1131(15 Feb 1974).

The recent result of Coleman and Weinberg deriving the one-loop quantum-corrected effective potential in a self-coupled scalar field theory is rederived using the Dyson-Schwinger equation. (auth)

20289 GAUGE FIELDS AND THE LORENTZ GROUP. Minkevich, A. V.; Kudin, V. I. (Belorussian State Univ., Minsk). Acta Phys. Pol.; B5: No. 3, 335-344(1974). (In Russian).

The role of the Lorentz group in the gauge field theory in the framework of the tetrad theory of gravitation is considered. It is shown that in the tetrad theory covariant with respect to arbitrary tetrad transformations no gauge field is connected with the Lorentz group. A gauge field of the third rank produced by the corresponding Noether invariant (the tetrad spin angular-momentum) is introduced by applying the gauge field theory to the group of tetrad Lorentz transformations with constant parameters. It is shown that in the limit of the special relativistic field theory the tetrad spin angular-momentum coincides with the spin angular-momentum of the fermion fields. (auth)

20290 COVARIANT PROPAGATORS AND VERTICES FOR HIGHER SPIN BOSONS. Ingraham, R. L. (New Mexico State Univ., Las Cruces). Progr. Theor. Phys. (Kyoto); 51: No. 1, 249-261(Jan 1974).

Covariant propagators and complete vertices for spin J bosons with conserved currents for all J are worked out. These explicit propagators have been given before (Fronsdal, Durand), but the nontrivial derivation has heretofore been lacking or too cryptic. Our complete vertices, which are new to our knowledge, involve an apt set of form factors modelled on the electromagnetic ones. The strongly absorbed one spin J boson-exchange helicity ampli-

tudes are given. The main application of these results is in realistic models, with explicit J-plane singularities, of the non-diffractive component of two hadron reaction amplitudes. The paper is presented as a useful tool and compendium for workers in this field. (auth)

20291 THIRD-ORDER EQUATION FOR TWO-COMPONENT SPINORS. Marx, E. (Harry Diamond Labs., Washington, DC). Int. J. Theor. Phys.; 9: No. 2, 75-91(Feb 1974).

The properties of a two-component spinor field that obeys a third-order equation is presented. It is separated into a massive part that corresponds closely to a Dirac field, and a massless part that obeys the Weyl equation. The interaction of such a field with an external electromagnetic field and the (weak) interactions of two such fields is discussed. They can be considered both in terms of relativistic quantum mechanics and quantum field theory. It is concluded that this formulation has some attractive features, such as a unified treatment of electrons and muons with their neutrinos, a special role of the Pe transformation, a more convergent propagator and a new approach to interactions. It also has some serious difficulties, aside from those generally associated with higher-order equations. These are mainly related to inconsistencies in the simultaneous considerations of electromagnetic and weak interactions. The approach also suggests a further unification of the electron and muon fields into a single bispinor field. (auth)

20292 HUGGINS TERM IN CURVED SPACE. Lovelock, D. (Univ. of Waterloo, Ont.). Lett. Nuovo Cim.; 10: No. 14, 581-584 (3 Aug 1974).

It was recently suggested that the energy-momentum tensor associated with the electromagnetic field in flat space–time should be modified by adding the Huggins term. The existence of a Huggins term in curved space, i.e., in an n-dimensional manifold X_n endowed with a symmetric metric tensor is discussed. (JFP)

20293 SCALING BEHAVIOR OF SUPERRENORMALIZABLE THEORIES. Marinaro, M.; Scarpetta, G. (Univ., Salerno, Italy). Lett. Nuovo Cim.; 10: No. 14, 633-635(3 Aug 1974).

A previous method is applied to the case of superrenormalizable theories. For concreteness the model of a neutral scalar field with $\Theta^3(x)$ interactions is considered. (JFP)

20294 LAGRANGE THEORY FOR SPINOR FIELDS OF SUBCANONICAL DIMENSION ½. Bigi, I. I.; Duerr, H. P.; Winter, N. J. (Max-Planck-Institut, Munich). Nuovo Cim.; 22A: No. 3, 420-447(1 Aug 1974).

A spinor field of subcanonical dimension ½ appearing as constituent field in a scale- and gauge-invariant nonlinear spinor field theory can be imbedded in a conventional Lagrange field theory with third-order derivatives. In this framework and by restricting the investigations to the corresponding "free" case the "currents", in particular the current proper, the energy-momentum tensor, the spin tensor and the dilatation current, can be constructed in classical analogy and quantization can be introduced along conventional lines. The theory can be cast into canonical form by introducing two additional spinor fields which are related to first- and second-order derivatives of the original field by Euler equations. The subcanonical spinor field theory appears as a certain projection of the canonical theory which has to be interpreted as a projection on the underlying state space in order to preserve the algebraic relations. The currents and as a consequence their commutators are not uniquely determined by their generator properties. To identify them with physical currents, additional conditions connected with the positive-definite metric of the physical subspace have to be required which single out the formal "Noether currents" of the canonical version of the theory as the only physically acceptable ones. As a consequence the leading singularities of the current commutator on the light cone are found to agree with those of the Dirac theory whereas the disconnected part contains a factor of three. (auth)

20295 $g\varphi^4$ QUANTUM FIELD THEORY IN THE STATIC ULTRALOCAL APPROXIMATION. Caianiello, E. R. (CNR, Arco Felice, Naples). Nuovo Cim.; 22A: No. 3, 448-460(1 Aug 1974).

The quantum theory of a neutral scalar field with interaction Lagrangian $g\varphi^4$ in the static ultra-local approximation which can be obtained by crossing out the kinematical term in the Hamiltonian. The model is exactly solvable and the behavior of $G_2(xy)$ as a function of the coupling constant is studied in detail. (auth)

20296 CONSERVATION LAWS IN LAGRANGIAN FIELD THEORIES WITH HIGHER-ORDER DERIVATIVES. Duerr, H. P. (Max-Planck-Institut, Munich). Nuovo Cim.; 22A: No. 3, 386-397(1 Aug 1974).

Lagrangian theories involving higher order derivatives are reconsidered. Such theories appear of great interest as an imbedding for field theories with fields of subcanonical dimension, like e.g. the Heisenberg nonlinear spinor theory, for which local interactions are less singular than in the canonical case. The conservation laws derived according to Noether and Bessel-Hagen are stated in a compact form. Quantization is introduced without making use of the canonical formalism. (auth)

20297 FIELD-THEORETICAL SPACE–TIME QUANTIZATION. Papp, E. (Institutul Politehnic, Cluj). Int. J. Theor. Phys.; 9: No. 2, 101-115(Feb 1974).

Using the framework of the quantum field theory it is proved that the possibility exists of performing—within binary description formalism—a suitable space-time quantization. In this respect the mutual connection between the action quantization and the space–time quantization has been established. (auth)

20298 ADDENDUM TO WILSON'S THEORY OF CRITICAL PHENOMENA AND CALLAN–SYMANZIK EQUATIONS IN 4-ELEMENT DIMENSIONS. Brezin, E.; Le Guillou, J. C.; Zinn-Justin, J. (CEN de Saclay, Gif-sur-Yvette, France). Phys. Rev., D; 9: No. 4, 1121-1124(15 Feb 1974).

In a previous work, it was shown how to derive the scaling laws near a critical point using renormalized perturbation theory. The calculations of the Callan-Symanzik functions β and γ which lead to the critical exponents are extended to next order in ϵ. The existence of a solution to the eigenvalue conditions $\beta(g) = 0$ in four dimensions, at fourth order in the coupling constant, is shown to be renormalization-dependent. (auth)

20299 NUMBER OF GREEN'S FUNCTION GRAPHS. Krupski, J. (Univ., Warsaw); Suffczynski, M. (Univ., Munich). Acta Phys. Pol.; A46: No. 1, 73-77(Jul 1974).

The recurrence formulas for the total number of linked and topologically non-equivalent diagrams for the one-particle and polarization Green's functions in arbitrary order of the perturbation are given. (auth)

20300 GAUGE INVARIANCE AND FOUR-FERMION INTERACTIONS. Palmer, R. F. Edmonton, Alberta; Univ. of Alberta (1972). 128p.

Thesis.

This thesis investigates the problem of a massive gauge invariant spin-one field and the problem of "ghosts" in theories that attempt to describe bound states. For the gauge problem it is shown that a skew-symmetric second rank tensor can be used to describe a spin-one quanta and that this formulation allows us to retain manifest gauge invariance. For the interaction of this field with a Dirac field it is shown that gauge invariance greatly restricts the possible form of the interaction Lagrangian. The theory obeys "Matthew's Rule" and the zero mass limit exists for certain S-matrix elements. A discussion of the relationship to the usual Proca formulation of the spin-one field and its minimal coupling to the Dirac field follows. Our interaction is equivalent to the minimally coupled form when the gauge is fixed, except for the appearance of a four-fermion term. Then we investigate some of the properties of four-fermion interactions in relation to the more general problem of bound state "ghosts". We make a detailed analysis of a modification to the Yukawa interaction. In this model a four-fermion term is added to the usual linear coupling of the pseudoscalar meson to the Dirac field. We find a bound state does exist but it is not a "ghost". Finally, the propagator for the vector field interacting with a Dirac field is examined and a bound state does not appear. (MGH)

20301 HYPERQUANTIZATION OF SPIN ½ AND SPIN 3/2 ELECTROMAGNETIC INTERACTIONS. Dormuth, K. W. Edmonton, Alberta; Univ. of Alberta (1971). 85p.

Thesis.

An approach to quantum field theory known as hyperquantization is reviewed. This formalism is then applied to the quantum electrodynamics of a spin ½ field. The result is a gauge invariant theory containing an operator S whose matrix elements agree with those of the conventional S-matrix of quantum electrodynamics, but in which the use of an indefinite metric can be avoided. Furthermore, the approach is used to quantize the system of interacting electromagnetic and spin 3/2 fields, and it is found that the well-known difficulty of negative field anticommutators does not arise. (auth)

20302 ELECTRODYNAMICS AND PROPAGATION OF A SPIN 3/2 FIELD. Capri, A. Z.; Shamaly, A. (Univ. of Alberta, Edmonton). Can. J. Phys.; 52: No. 10, 919-920(15 May 1974).

We show that if a charged Rarita–Schwinger spin 3/2 field is coupled both to an internal as well as external electromagnetic field, acausal propagation will always occur regardless of the external field. Thus the electrodynamics of a Rarita–Schwinger spin 3/2 field is not consistent with special relativity. (auth)

20303 HIGHER SPIN FIELD INTERACTIONS. Shamaly, A. Edmonton, Alberta; Univ. of Alberta (1972). 119p.

Thesis.

A general method of finding first-order wave equations without subsidiary conditions for integer spin and finite mass is described.

Spin 0, 1, 2 and 3 are examples used to illustrate this method. We also show that for interacting fields: The spin one theory of Takahashi and Palmer leads to acausal propagation when minimally coupled to an electromagnetic field. The addition of an anomalous magnetic moment (Pauli term) allows one to recover causal propagation. In the case of Rarita-Schwinger spin $3/2$ theory it is impossible to obtain causal propagation even when all possible Pauli terms are included. Coupling of a massive spin $1/2$ and massive spin 1 fields leads to causal propagation for all nonderivative scalar, pseudo-scalar, vector, pseudo-vector, and the derivating coupling of vector and tensor types; while the derivative coupling of the scalar, pseudo-scalar, pseudo-vector leads always to acausal propagation. Finally we show that the causal Takahashi-Palmer field leads to the same vacuum polarization as that of the Proca field. (auth)

20304 POSITIVITY OF THE HAMILTONIAN SEMIGROUP AND THE CONSTRUCTION OF EUCLIDEAN REGION FIELDS. Simon, B. (Eidgenoessische Technische Hochschule, Zurich). Helv. Phys. Acta; 46: No. 5, 686-696(1973).

Conditions under which a Wightman field theory can be "continued" to a field theory in the Euclidean region are presented. A basic role is played by the condition that the semigroup e^{-tH} be positivity preserving in the realization of the physical Hilbert space diagonalizing the time zero fields. Finally a model is presented in one-dimensional space time obeying all the Osterwalder–Schrader axioms without an associated Euclidean region field. (auth)

20305 FERMION–FERMION INTERACTION IN CONSTRUCTIVE QUANTUM FIELD THEORY. Manoukian, E. B. Toronto; Univ. of Toronto (1971). 204p.

Thesis.

A cut-off field theory describing the interaction of two distinguishable fermions in the Hamiltonian formalism is studied. It is shown that the cut-off Hamiltonian is a self-adjoint operator in Fock space and its spectrum is bounded from below by the energy of the ground-state which is strictly negative. Without a space cut-off, it was proven that the lower bound of the Hamiltonian is minus infinity. The existence and uniqueness of the vacuum-state vector of the cut-off Hamiltonian is proven for a sufficiently small coupling constant and then by a different method its existence is proven but not its uniqueness for any coupling constant. Using in the process the self-adjointness of the cut-off Hamiltonian the interacting fields are constructed, and it is proven that they satisfy the usual nonlinear field equations in the sense of distributions. From the existence of a vacuum-state vector, the Wightman distributions are constructed, and their equations of motion derived. It is shown that although the cut-off Hamiltonian does not necessarily exist as an operator in Fock space in the infinite volume limit, the smeared fields do exist and define bounded operators. The existence of the Wightman functions as tempered distributions in the infinite volume limit is then proved. It is shown that the expectation values of all self-adjoint operators in the von Neumann algebra generated by the spin-momentum distribution observables in the scattering states approach asymptotically in time to their free counterparts. This von Neumann algebra is proven to be maximally abelian and any measurement of spins and momenta can be described in terms of operators in this algebra. (MGE)

20306 ON THE CALCULATION OF NONLINEAR SPINOR FIELD FUNCTIONALS. P. 2. Stumpf, H. (Tuebingen Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Z. Naturforsch., A.; 29: No. 4, 549-555(Apr 1974).

9 refs.

In preceding papers a functional quantum theory has been developed. In this theory the physical observables are derived only by functional operations from the corresponding state functionals. To obtain physical information, the state functionals have to be known and calculational procedures have to be developed. As high energy phenomena are of interest, the state functionals of the nonlinear spinor field are considered. A calculation method for bound state functionals is proposed. This method is extended to the calculation of scattering state functionals, resulting in channel equations for the various scattering processes in the dynamics of the nonlinear spinor field. (auth)

20307 SOME REMARKS ON LOCAL OPERATORS IN QUANTUM ELECTRODYNAMICS. Ferrari, R.; Picasso, L. E. (Instituto Nazionale di Fisica Nucleare, Pisa (Italy)); Strocchi, F. (Princeton Univ., N. J. (USA). Joseph Henry Labs.). Commun. Math. Phys.; 35: No. 1, 25-38(Jan 1974).

7 refs.

The existence of a conserved current which generates locally gauge transformations of first kind is assumed. Work is done in a local quantum field theory, where the fields are defined on a vector space where indefinite metric is allowed. It is shown that the Maxwell equations are not consistent with the above assumptions and the vectors obtained by applying local charged operators on the vacuum cannot describe physical states. Moreover it is shown that, if charged fields have nontrivial expectation value on the physical states, the vector space must contain vectors with negative norm. The relation between the local formulation of QED and a formulation in terms of physical states is discussed. As an example the transition from Gupta-Bleuler free QED to the Coulomb-gauge formulation is studied. (auth)

20308 THE UNITED FIELD THEORY OF ELEMENTARY PARTICLES; SOME RECENT ADVANCES. Heisenberg, W. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)). Naturwissenschaften; 61: No. 1, 1-5(Jan 1974).

1 tab.; 25 refs.

Progress in the unified field theory of elementary particles over the last seven years includes experimental verification of the scale group and its application in theoretical investigations; connecting the unified field theory with phenomenological current algebra; exploring the consequences of the indefinite metric for the problem of casuality and the classification of leptons; elaboration of methods for the calculation of mass eigenvalues; and experimental verification of the predicted behavior of cross sections at extremely high energies. (auth)

20309 LADDER EXCHANGE IN φ^3 THEORY AND SELECTED TOPICS IN THE DUAL-RESONANCE MODEL. Sinclair, D. K. Stony Brook, NY; State Univ. of New York (1971). 122p. University Microfilms Order No. 72-6389.

Thesis (Ph. D.).

The asymptotic behavior of N-tower exchange is examined using Feynman parameter techniques. The two-tower asymptotic behavior is calculated explicitly in the leading log s approximation, and it is found that it gives the second term of the eikonal expansion. Certain assumptions enable one to calculate the N-tower case iteratively, since only a limited set of graphs are found to contribute. Summing over N yields the eikonal form in agreement with momentum space calculations. The level structure of the Balachandran generalization of the Veneziano N-point function is considered. The model is shown to exhibit consistent simple and multiple factorization. Use of the harmonic oscillator formalism of Fubini-Gordon–Veneziano enables one to isolate vertex and propagator functions. The degeneracy of the n-th level is shown to be of the form exp-(const $n^{\frac{1}{4}}$) for large n. It is seen that the Gross model has similar asymptotic degeneracy, in contradiction to previously published results. Various models for currents in the dual resonance model are considered. The connection between the generalized Leutwyler and Nambu infinite component wave equations is noted. The Kikkawa-Sato current amplitude is shown to be nondual. Twisting the Leutwyler current is shown to produce the Brower–Weis current amplitude. It is shown that the Bouchiat-Gervais–Sourlas two current amplitude has an unphysical pole structure. (Diss. Abstr. Int., B)

Gravitation and General Relativity

Refer also to abstract 19753.

20310 (RL-74-38, pp Paper 8) GRAVITATIONAL WAVE EXPERIMENTS. Drever, R. W. P. (Glasgow Univ.). 1973.

From school for young high energy physicists; Chilton, UK (15 Jul 1973).

A review is presented of the experiments done or in progress in an attempt to detect gravitational radiation. The nature of the radiation is discussed, and possible sources such as the collapse of the core of a star in a supernova outburst. The experiments of Professor Weber at the University of Maryland are described, and those of later groups elsewhere, in particular in the laboratory at the University of Glasgow. Methods of analyzing the experimental results are discussed. It is possible that the sensitivity of present experiments is insufficient, and techniques for higher sensitivity are considered. (UK)

20311 QUANTUM CORRECTIONS TO THE SCHWARZSCHILD SOLUTION. Duff, M. J. (International Centre for Theoretical Physics, Trieste, Italy). Phys. Rev., D; 9: No. 6, 1837-1839(15 Mar 1974).

The quantum field theory of gravitation is used to compute quantum corrections to the classical Schwarzschild solution of the Einstein equations. The event horizon at $r = 2M$ must now be modified, and there are indications that quantum effects may prevent the appearance of the intrinsic singularity at the origin. (auth)

20312 NEUTRINOS IN GENERAL RELATIVITY: FOUR (QUERY) LEVELS OF APPROACH. Kuchowicz, B. (Univ., Warsaw). Gen. Relativity Gravitation; 5: No. 2, 201-234(Apr 1974).

The three subsequent levels of approach to the problem of the neutrino in general relativity which have been exploited till now, are: "classical particle" approach, i.e., a study on the neutrino as a classical particle in a classical, given gravitational field; "quantum particle" approach, i.e., considering the Dirac equation for the neutrino in a given gravitational field; "classical field" approach comprising the study of combined neutrino-gravitational fields. Many results obtained along these lines are presented, with emphasis upon the geometrical theory of two-component neutrino-gravitational fields. A synthesis of the particle and fields aspects of the neutrino could provide a possible fourth, till now nonexisting, "quantum field" level of approach. This should deal with a quantized neutrino field in a curved space-time (which might be also quantized, but perhaps this should belong already to a next, fifth level of approach). Studies on the neutrino physics in gravitational fields reveal not only a series of results which are of interest in se, and which may be used as the basis to a unified theory of neutrino and gravitational fields (the Rainich problem for the neutrino). They provide in addition the necessary material for astrophysical and cosmological applications; some of these are outlined in relation to the results presented. (auth)

20313 GENERALIZED EQUATIONS OF MOTION. II. The Integration of Generalized Systems of Dynamical Equations. Liebscher, D. E. (Zentralinstitut fuer Astrophysik, Potsdam, Ger.). Ann. Phys. (Leipzig); 31: No. 3-4, 321-328(1973).

A set of tensors is considered, whose covariant divergences are linear combinations of the set. These divergence relations generalize the dynamical equation $T^{kl}; k = 0$ by including covariant forces and other tensors besides the energy tensor. By generalizing the Fock–Papapetrou method one gets a covariant set of equations of motion. (auth)

20314 CORRECTNESS OF THE EINSTEIN EQUIVALENCE PRINCIPLE. Valikhodzhaev, Sh. M. (Tashkent Inst. of Textile and Light Industry). Dokl. Akad. Nauk Uzb. SSR; No. 2, 21-22 (1974). (In Russian).

The conclusion of V. A. Fok that that there can not be complete equivalence of acceleration and gravitational fields is refuted. (JSR)

20315 GENERALIZED EQUATIONS OF MOTION. I. The Equivalence Principle and Non-Riemannian Space–Time. Liebscher, D. E. (Zentralinstitut fuer Astrophysik, Potsdam, Ger.). Ann. Phys. (Leipzig); 31: No. 3-4, 309-320(1973).

It is shown that no generalization of the affinity introduced in the the Dirac equation may change the geodesic motion of pole particles. One cannot deduce the lemma of Ricci or absence of torsion by the mere fact that this yields in the case of the affinity to be used in the dynamical equation. (auth)

20316 EINSTEIN'S STATIONARY SPHERICALLY SYMMETRIC CLUSTER OF PARTICLES. Teixeira, A. F. da F.; Som, M. M. (Centro Brasileiro de Pasquisas Fiscias, Rio de Janeiro). J. Phys., A (London); 7: No. 7, 838-842(1 May 1974).

It is shown that Einstein equations allow a special class of stationary solutions which correspond to spherically symmetric clusters of particles in circular motions, the total angular momentum of the cluster being zero, and all orbits being performed with the same period. The mass density of such clusters is everywhere regular and positive, decreasing with increasing radius. (auth)

20317 CONSERVATION EQUATIONS AND EQUATIONS OF MOTION IN THE NULL FORMALISM. Goldberg, J. N. (Syracuse Univ., NY). Gen. Relativity Gravitation; 5: No. 2, 183-200(Apr 1974).

The object is to relate three equations in the Newman-Penrose system of equations to the conservation laws and, hence, to the equations of motion. To do so, the corresponding result is first obtained using the Einstein equations in a null coordinate system. The Newman-Penrose equations are then analyzed. They are separated into hypersurface, propagation, supplementary, and conservation equations. When all field equations except the three conservation equations have been appropriately satisfied, the desired result follows. (auth)

20318 SPACE TIMES OF EMBEDDING CLASS ONE IN GENERAL RELATIVITY. Barnes, A. (Newcastle Upon Tyne Univ., Eng.). Gen. Relativity Gravitation; 5: No. 2, 147-162(Apr 1974).

The algebraic structures of both the Ricci and Weyl tensors, given that of the second fundamental tensor, are tabulated. In particular, the Weyl tensor is algebraically special if and only if the second fundamental tensor is algebraically special. A class one perfect fluid is found to possess at least one of the following properties: (a) a conformal flatness; (b) the flow is geodesic; (c) it admits a three-dimensional group of isometries with two-dimensional space-like trajectories. All solutions with property (b) are obtained explicitly. (auth)

20319 SLOW MOTION APPROXIMATIONS IN GENERAL RELATIVITY. 2. Gauge Tranformations. Dixon, W. G. (Cambridge Univ., Eng.). Gen. Relativity Gravitation; 5: No. 2, 119-137(Apr 1974).

When the field equations of general relativity are expanded in powers of a small parameter, the general co-variance of the exact theory implies a corresponding gauge invariance of the equations obtained in the expansion. In a slow motion expansion, the derivation of this gauge transformation is complicated by the fact that the time coordinate is singled out for special treatment. In a previous paper (Dixon, Gen. Rel. Grav.; 3: 227-49(1972)), a new (3 + 1)-dimensional decomposition of the field equations was obtained which is particularly suitable as a starting point for slow motion approximations. A systematic method is given again using covariant techniques throughout, for obtaining the corresponding gauge transformations to arbitrarily high accuracy. The calculations are explicitly carried out as far as is required in the $2\frac{1}{2}$-post-Newtonian approximation. (auth)

20320 GENERAL THEOREMS IN BRANS–DICKE AND HOYLE–NARLIKAR COSMOLOGIES. Banerji, S. (Dublin Inst. for Advanced Studies). Phys. Rev., D; 9: No. 4, 877-882 (15 Feb 1974).

Raychaudhuri-type equations are written for cosmological models filled with a perfect fluid and obeying the Brans–Dicke and Hoyle–Narlikar field equations. In addition, the following three theorems are proved: (1) The only possible spatially-homogeneous stationary models of the universe of perfect fluid obeying the Brans–Dicke theory are the radiation-filled and the perfectly empty universe. (2) If the creation is absent in the C-field theory of Hoyle and Narlikar, the existence of the slightest pressure will prevent an expansion or a contraction. (3) A spatially homogeneous rotating universe filled with incoherent dust and having a shear-free expansion is ruled out by C-field cosmology (of Hoyle and Narlikar) without creation. (auth)

20321 EXACT SOLUTIONS OF EINSTEIN FIELD EQUATIONS. Chakravarty, S. (Northwestern Univ., Evanston, IL). Phys. Rev., D; 9: No. 4, 883-884(15 Feb 1974).

We obtain exact exterior solutions of a rotating infinite cylinder. In addition to two different solutions obtained before, a new solution is found which is finite on the axis. It seems that these three solutions exhaust the possibilities. (auth)

20322 CHARGED DUST SPHERES IN GENERAL RELATIVITY. Missra, R. M.; Srivatava, D. C. (Univ. of Gorakhpur, India). Phys. Rev., D; 9: No. 4, 844-849(15 Feb 1974).

The nonstatic Einstein-Maxwell equations with incoherent matter as source are investigated with a view towards discussing the role of electrical forces during the collapse of a spherical body. It has been shown that the system does not admit nonstatic solutions with isotropic collapse. An expression for the ratio of mass and charge densities is obtained which is found to depend on three arbitrary functions of the radial coordinate. The significance of these arbitrary functions in terms of the physical variables of the system is given. The results are then applied to the case of uniformly charged dust models, and a nonexistence theorem for obtaining a class of solutions is derived. (auth)

20323 LARGE SCALE STRUCTURE OF SPACE–TIME. Hawking, S. W.; Ellis, G. F. R. Cambridge Monographs on Mathematical Physics. New York; Cambridge University Press (1973). 399p. $28.50.

The discussion covers the role of gravity, differential geometry, general relativity, the physical significance of curvature, exact solutions, causal structure, the Cauchy problem in general relativity, space–time singularities, gravitational collapse, and black holes, and the initial singularity in the universe. (JFP)

20324 DYNAMICS OF THE GRAVITATIONAL FIELD. II. Dozmorov, I. M. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 40-47 (1973). (In Russian).

In this study a previously proposed variant of the dynamic theory of the gravitational field is compared with other well known theories. An analysis of two exact solutions of the Einstein equations is carried out. The results coincide with those obtained earlier in other studies. (SJR)

20325 DYNAMICS OF GRAVITATIONAL FIELD. III. Dozmorov, I. M. (All Union Scientific Research Inst. of Optical Physics, Moscow). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 8, 47-54(1973). (In Russian).

This study investigates the dynamic characteristics of a system of limited sources with gravitational emission. Calculations are

made on the gravitational forces acting on test particles, the energy density, the total energy of the system and the total flux of gravitational energy. These determinations are compared with those obtained earlier by other researchers. (SJR)

20326 PHENOMENOLOGICAL MODIFICATION OF EINSTEIN'S GRAVITATIONAL LAGRANGIAN. Narlai, H. (Hiroshima Univ., Takehara, Japan). Progr. Theor. Phys. (Kyoto); 51: No. 2, 613-627 (Feb 1974).

A phenomenological approach to the modification of Einstein's gravitational Lagrangian is proposed, in order to arrive at a regular isotropic model-universe being stable with respect to the excitation of gravitational and rotational waves in such a way that the modification does not seriously disturb the success of general relativity for the solar gravitational field. It is shown that the substratum of our model-universe at the bounce epoch must be dominated by the hadronic matter whose density is not lower than $5 \times 10^{46} g/cm^3$, if we stand on Hagedorn's picture for supra-nuclear matter. It is noticeable that our Lagrangian is equivalent to Einstein's, so far as a static and spherically symmetric vacuum field is concerned. Several interesting problems to be studied on the basis of our modified theory of general relativity are also touched upon. (auth)

20327 SCALAR-TENSOR THEORIES AND THE WAVE EQUATION. Tupper, B. O. J. (Univ. of New Brunswick, Fredericton). Lett. Nuovo Cim.; 10: No. 14, 627-628 (3 Aug 1974).

In order to remove the arbitrariness of two functions for the most general action principle for a scalar-tensor theory, the action principle was restricted in the absence of sources by insisting that it should lead to a given wave equation. (JFP)

20328 MODEL FOR GRAVITATING PARTICLES IN QUANTUM THEORY. Efinger, H. J. (Univ. of Otago, Dunedin, New Zealand). Acta Phys. Austr.; 37: No. 4, 343-349 (1973).

An elementary model for gravitating particles in quantum theory is developed. The particles are described in the one particle Schrödinger formalism, whereas the gravitational field is treated as a linearized quantum-scalar field in nonrelativistic approximation. Interrelations between fundamental constants are discussed, which seem to also follow from more elaborate schemes such as quantum geometro-dynamics. (auth)

REACTOR TECHNOLOGY AND REGULATION

20329 (BNWL-tr-112) INVESTIGATIONS ON THE MECHANICAL BEHAVIOR OF THE CYLINDRICAL FUEL RODS IN A NUCLEAR REACTOR. Lassmann, K. (Technische Univ., Darmstadt (F. R. Germany). Inst. fuer Reaktortechnik). 24 Apr 1974. Translation by F. Neffgen of KFK-1853. 227p. Dep. NTIS $14.50.

Thesis.

The mechanical behavior of cylindrical fuel elements is analyzed. A review concerning the physics and technology of fuel elements is presented along with discussions of element behavior as related to axial symmetry taking into account creep, swelling, and plasticity. Theoretical and numerical solutions (SPAR computer program) are offered for isotropic and anisotropic material properties with any given locality dependence. A theory is developed for the description of anisotropic creep (e.g., in the case of Zircaloy fuel cans in light water reactors). Creep buckling of fuel elements is also examined. The structure of the cladding and the supporting fuel "ring" is replaced by a sandwich model. A numerical method is being developed for the solution (numerical sandwich method). Special cases are described to prove that the accuracy of the method is higher than the accuracy of the data on the materials. (auth)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstract 20424.

20330 (ANS-RPD-4, pp 55-62) EFFECTS OF PLUTONIUM CHARACTERISTICS ON RELOAD FUEL DESIGN FOR LWR'S. Tomonto, J. R.; Hamilton, G. T. (United Nuclear Corp., Elmsford, NY). [nd].

From proceedings on physics of plutonium recycle; Miami, Florida, USA (Oct 1971).

In special session of invited papers on physics of plutonium recycle.

Plutonium recycle is discussed from the standpoint of the effects on reload core design of (1) the higher thermal cross sections of plutonium, (2) the importance of the isotopic chains, and (3) the smaller delayed neutron yield. (auth)

20331 (ANS-RPD-4, pp 81-91) REVIEW OF THE ITALIAN ACTIVITIES FOR THE THERMAL RECYCLING OF PLUTONIUM. Schileo, G. (CNEN, Rome). [nd].

From proceedings on physics of plutonium recycle; Miami, Florida, USA (Oct 1971).

In special session of invited papers on physics of plutonium recycle.

A brief status report on the various activities conducted or in progress in Italy in the area of plutonium recycle in light water reactors is presented. (auth)

20332 (ANS-RPD-4, pp 144-146) BWR Pu RECYCLE PHYSICS. Crowther, R. L.; Fischer, D. L. [nd].

From proceedings on physics of plutonium recycle; Miami, Florida, USA (Oct 1971).

In special session of invited papers on physics of plutonium recycle.

A summary of comparisons of theoretical and experimental data on plutonium recycle is presented to provide a basis for design of BWR plutonium recycle fuel assemblies. (auth)

20333 (PB-228858) REVIEW AND ANALYSIS OF RADWASTE MANAGEMENT FOR LIGHT WATER REACTORS. Paper No. 71-10. Franco, J. A.; Cady, K. B. (Cornell Univ., Ithaca, N. Y. (USA)). Aug 1971. 46p. NTIS $5.50.

The performance of present generation BWRs and PWRs is analyzed in terms of radwaste system design and management and effluent release. Present methods of low level waste treatment are "dilution and dispersal" using a combination of the standard engineering practices of filtration, demineralization, and evaporation, coupled with dispersal through stacks or into natural bodies of water. Releases can be reduced significantly by a shift to a "concentrate and contain" method for low level waste streams and the application of new technologies. Liquid waste reductions can be achieved by increased purification and recycling of plant water. Noble gas removal schemes have received much attention and presently three methods have been demonstrated or are nearing readiness for large scale commercial operation: charcoal adsorption, cryogenic distillation, and refrigerte absorption. Tritium removal processes are still to be developed; meanwhile, PWRs are moving toward recycling of reactor coolant water allowing tritium concentration to build up. (auth)

20334 WELDING OF PIPES IN CONSTRUCTION OF A NUCLEAR POWER PLANT. Tanaka, H.; Tega, M. (Ishiwajima-Harima Heavy Industries Co. Ltd., Tokyo). Haikan Gijutsu; 15: No. 13, 43-50(Sep 1973). (In Japanese).

In welding of pipes containing radioactive substances in nuclear power plants, adequate care must be taken in planning, working and quality control. Taking the BWR as an example, the following are described: the methods of welding; operation control and personnel control; welding quality control; and peculiarities in the reactor plant welding. The welding methods to be applied must be approved beforehand by the government. In performing welding, regardless of the methods, both welding personnel and operation must meet specifications. Finally, to keep up with the requirements of regulations, the quality control of welds is stringent. Among the peculiarities are welding procedure and technical aspects. (JA)

20335 DEVELOPMENT OF JET PUMPS FOR BOILING WATER REACTOR RECIRCULATION SYSTEMS. Kudirka, A. A.; Gluntz, D. M. (General Electric Co., San Jose, CA). J. Eng. Power; 96: No. 1, 7-12(Jan 1974).

From Joint Power Generation Conference; New Orleans, LA (16 Sep 1973).

Jet pumps are used inside the reactor pressure vessel as part of the reactor recirculation system to circulate subcooled water at about 530°F. The development of the first-generation and improved, second-generation jet pumps is surveyed, and the economic advantages of using them in a reactor are discussed. The development, geometry, and performance of these two jet pumps are described, their performance is compared, and the significant increase in efficiency obtained, resulting in the highest value reported in literature, is illustrated. (auth)

20336 EMERGENCY COOLING IN NUCLEAR POWER PLANTS. P. 2. Wolf, L. (Technische Univ. Berlin (F. R. Germany). Inst. fuer Kerntechnik). Energie; 26: No. 3, 119-121(Mar 1974). (In German).

From emergency cooling in nuclear power plant-evaluation from the assessor's point of view; Koeln, F. R. Germany (8 Nov 1973).

The problems of emergency cooling of BWR and PWR type reactors are discussed. The main topics of the discussion can be grouped under the following heading: a) theoretical models and their experimental bases, b) reliability analyses, c) safety criteria. (GE)

20337 WE ARE NO SUICIDES. OeTV-Magazin; No. 5, 17-18(May 1974). (In German).

2 figs.

Report on a visit to the Gundremmingen nuclear power plant is presented with comments by operating personnel on problems of reactor safety and operation. (GE)

20338 STEAM SEPARATING MEANS FOR BOILING WATER REACTORS. Mansson, R.; Nilsson, L.; Noberius, L.; Sundqvist, C. (to Aktiebolaget Asea-Atom). US Patent 3,821,078. 28 Jun 1974. Priority Date 28 Sep 1971, Sweden. 6p.

A boiling water reactor which comprises a reactor tank and a moderator tank located inside the reactor tank has a lid with a plurality of upstanding pipes opening into steam separators. The steam separators are secured together in groups, and each group is clamped to the lid. Each steam separator has a rising tube and each unit has a bell-shaped casing common to the group and surrounding the steam separators to provide a falling surface for the water separated in the unit. Deflection caps connected together in groups corresponding to the groups of steam separators are mounted above the open tops of the steam outlet tubes of the separators. (Official Gazette)

20339 SPACER FOR FUEL RODS OF NUCLEAR LIGHT-WATER REACTORS. Froemel, G. (to Siemens Aktiengesellschaft). US Patent 3,819,477. 25 Jun 1974. Priority Date 10 Dec 1971, F. R. Germany. 4p.

The spacer consists of two grid elements arranged in parallel to one another and spaced apart at a distance; leaf springs for the fuel rods; and spacer bushings which extend between the two grid elements in positions provided for control rod guide tubes. Each spacer bushing encloses an associated control rod guide tube. The spacer bushing is connected with the grid elements and also with the associated control rod guide tube at at least one point, preferably by spot welding. (Official Gazette)

20340 BOLT TENSIONING DEVICE ESPECIALLY ADAPTED FOR USE WITH NUCLEAR REACTOR PRESSURE VESSEL. Jones, C. R. (to Transfer Systems Inc.). US Patent 3,815,874. 11 Jun 1974. Filed Date 18 Oct 1971. 10p.

An improved bolt tensioning device for use for loosening or tightening the bolts which secure the pressure head to a nuclear reactor pressure vessel is described. The improved tensioner comprises a head bearing member which surrounds the bolt nut and has an annular ledge defining with an overlying complementary mating piston member an annular pressurized fluid receiving chamber. A connection to the bolt stud is constituted by a split sleeve or ring which is placed in threaded engagement with the stud above the fluid receiving chamber and held in place therein by a surrounding retainer sleeve via matching tapered surfaces. A bearing washer with curved bearing surface is interposed between the upwardly urged complementary member and the split ring for transmitting the upward force to the latter and via the latter to the stud. (Official Gazette)

20341 FUEL ELEMENT WITH FAILURE INDICATOR. Goldman, A. J.; Rowe, D. G.; Jones, C. R. (to Transfer Systems Inc.). US Patent 3,813,286. 28 May 1974. Filed Date 8 May 1972. 6p.

A novel fuel element for use in a power-generating nuclear reactor is described. The fuel element features a built-in indicator to indicate failure, and is especially adapted for use in a fuel assembly having a removable top closure. In a preferred embodiment, the indicator is a spring loaded movable pin which is displaced outwardly when the reactor is shut down by the internal element gas pressure. Should the element develop a leak, the spring causes retraction of the pin indicator. A failure sensor is also described. (Official Gazette)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 20330, 20331, 20333, 20336, 20339, 20341, 20419, 20424, 20430–20434, 20436, and 20437.

20342 (ANS-RPD-4, pp 1-11) PROBLEMS IN RECYCLE OF PLUTONIUM IN PRESSURIZED WATER REACTORS. Hellens, R. L. (Combustion Engineering, Inc., Windsor, CT). [nd].

From proceedings on physics of plutonium recycle; Miami, Florida, USA (Oct 1971).

In special session of invited papers on physics of plutonium recycle.

The basic physics problems of plutonium recycle in thermal power reactors are reviewed from the point of view of the experimental data and the status of the theory. The principal differences between uranium and plutonium fuel are reviewed, and the characteristics of self-generated recycle are discussed in order to illustrate some of the unusual physics problems encountered. An analysis of critical experiments is given. (auth)

20343 (IAEA-PL-504-4) STUDY CONCERNING THE REACTOR COMPONENTS AND NUCLEAR POWER PLANTS. Some Aspects of the French Experience. Befre, J.; Chantot, H.; Cuisenier, R.; Le Ber, J. (International Atomic Energy Agency, Vienna (Austria)). 1972. 42p. (In French). INIS.

Modifications of the following reactor components are described: (1) the internal structures and the steam generators of the Ardennes (PWR) reactor, (2) the rotating plugs of the Rapsodie (LMFBR) reactor, and (3) the pressure tube of the EL-4 (HWGCR) reactor. (tr-auth)

20344 STOP SHRINK AND SWELL OSCILLATIONS IN THE NUCLEAR POWER PLANT. Upgrade Safety and Extend Life. Forman, P. Combustion; 45: No. 12, 30-32(Jun 1974).

The behaviour of a PWR steam generator water-level controller is described by means of a mathematical model which describes the steam drum water-level oscillations which can adversely affect reactor performance. It is shown via the model that a reduction in the time constant of the feedwater value eliminates the oscillation. (DG)

20345 SYSTEM-80 COMBUSTION ENGINEERING'S STANDARD 3800-MW(t) PWR. Bevilacqua, F.; Gibbons, J. F. Combustion; 45: No. 12, 14-25(Jun 1974).

From American Power Conference; Chicago, IL (29 Apr 1974).

A nuclear steam supply system is described with emphasis on design features reflecting industry attention to fuel densification, ECCS, inservice inspection, power limitations, standardization, power escalation, plutonium recycle, decreased refueling time, and increased maneuverability. General design characteristics are listed, and component diagrams and descriptions are given. (DG)

20346 VOLUME COMPENSATION OF NUCLEAR POWER STATION PRIMARY CIRCUIT. Strmiska, F.; Buchnickova, Z. Jad. Energ.; 20: No. 3, 85-88(Mar 1974). (In Czech).

A volume compensation system in the primary circuit of a nuclear power station with a pressurized-water reactor is discussed. Results of the investigation important for steam and gas pressurizer design are summarized. Some numerical results of theoretical calculations of the steam pressurizer IBZKG characteristics are presented. (auth)

20347 CONSTRUCTION OF THE VESSELS AND STEAM GENERATORS OF PWR REACTORS. Tech. Mod.; No. 3, 51-53 (Mar 1974). (In French).

A brief review of the construction of vessels and steam generators of pressurized water reactors is presented together with a description of the facilities available in the heavy machining and assembly workshops at Creusot and Chalon-sur-Saone. (FR)

20348 OUTLINE OF PIPING INSTALLATION IN A NUCLEAR POWER STATION. Harada, S.; Benitani, O. (Mitsubishi Heavy Industries, Ltd., Kobe, Japan). Haikan Gijutsu; 15: No. 13, 55-68(Sep 1973). (In Japanese).

The design, fabrication, and installation of piping in PWR power plants are discussed. (JA)

20349 NEW ANALYTICAL MODEL FOR PWR CORE SIMULATION. ASSY-CORE Code System. Morioka, N.; Yokote, M. (Kanasai Electric Power Co. Inc., Osaka). Nippon Genshiryoku Gakkaishi; 16: No. 4, 198-205(Apr 1974). (In Japanese).

It has been established from detailed analysis of the PWR core that the fast neutron flux is nearly flat within the fuel assembly, and that thermal neutron diffusion is largely limited to the space between fuel assemblies. Based on these two assumptions, a new computing program has been developed for PWR core analysis, which is better than the currently used FLARE, in that it yields more accurate results with shorter computing time. The accuracy of this computer program is verified by comparison of results with measured data as well as with two-dimensional two-group diffusion calculations. (auth)

20350 JACKETING FOR AN ASSEMBLY OF NUCLEAR REACTOR FUEL ELEMENTS. Thome, P. (to Babcock-Atlantique SA). US Patent 3,823,066. 9 Jul 1974. Priority Date 29 Apr 1971, France. 6p.

Electron beam welding is used to join the lateral plates that surround the fuel elements in a nuclear reactor core without deformation through a proper welding sequence. Baffle-plates or partitions, moreover, also are stud-welded to the lateral plates without deformation through the electron beam process. The upper circumferential part of the completely assembled structure ultimately is welded to the reactor core barrel. Screwjacks also are provided to quickly position the structure over a lower grid. This technique eliminates the usual threaded fasteners and the need for accurate lower core barrel machining operations. (Official Gazette)

20351 STAGGERED CONE DEFLECTORS. Calvin, J. N. (to Combustion Engineering Inc.). US Patent 3,814,666. 4 Jun 1974. Filed Date 4 Jan 1971. 6p.

A flow deflector is described for cooling fluid flowing longitudinally in channels between spaced parallel nuclear fuel reactor elements positioned laterally by intersecting grid elements. The deflector comprises a plurality of cones positioned at the intersection of the grid elements with their apexes pointed upstream to deflect the flow laterally toward and across the fuel elements and arranged in spaced staggered relation at different elevations on the grid to reduce flow resistance. (Official Gazette)

20352 PRESSURIZED WATER NUCLEAR REACTOR WITH UPPER AND LOWER CORE SUPPORT AND POSITIONING MEANS. Jabsen, F. S. (to Babcock and Wilcox Co.). US Patent 3,821,079. 28 Jun 1974. Filed Date 9 Sep 1970. 6p.

A pressurized water nuclear reactor is described wherein the core in the lower portion of the reactor pressure vessel is supported from the lower closure of the vessel and the parts in the upper part of the reactor vessel including the control rod guide tubes are supported from the upper part of the vessel. Differential movements between parts supported from the top and bottom of the pressure vessel as caused by thermal changes are guided in a vertical direction and restrained in a transverse direction to maintain axial alignment of the parts. (Official Gazette)

20353 INDUSTRIAL TECHNIQUE. Pocock, F. J.; Leedy, W. G. (to Babcock and Wilcox Co.). US Patent 3,819,476. 25 Jun 1974. Filed Date 1 Sep 1971. 8p.

In an illustrative embodiment of the invention, approximately 0.1 percent by weight of sodium silicate is added to an aqueous radioiodine absorbing and decay heat removing spray mixture for

discharge within a nuclear reactor containment building. The radioactive decontamination fluid preferably includes 1 percent by weight of sodium thiosulfate, 1.22 percent by weight of boric acid and 0.528 percent by weight of sodium hydroxide in a water solution. The added sodium silicate allows less expensive aluminum components to be used within the containment building because it inhibits a corrosive chemical reaction between the aluminum and the sodium hydroxide. Without the inhibitor, the aluminum-hydroxide reaction would lead to a potentially explosive mixture of hydrogen and oxygen within the containment building. (Official Gazette)

20354 NUCLEAR REACTOR INTERNALS CONSTRUCTION AND FAILED FUEL ROD DETECTION SYSTEM. Frisch, E.; Andrews, H. N. (to Westingouse Electric Corp.). US Patent 3,817,829. 18 Jun 1974. Filed Date 21 Jan 1972. 8p.

A system is provided for determining during operation of a nuclear reactor having fluid pressure operated control rod mechanisms the exact location of a fuel assembly with a defective fuel rod. The construction of the reactor internals is simplified in a manner to facilitate the testing for defective fuel rods and to reduce the cost of producing the upper internals of the reactor. (Official Gazette)

20355 FUEL ASSEMBLY HOLD-DOWN DEVICE. Klumb, R. H.; Hutchinson, J. J. (to Combustion Engineering Inc.). US Patent 3,814,667. 4 Jun 1974. Filed Date 20 May 1971. 10p.

The invention provides a hold-down device which maintains a net downward force on a fuel assembly in a nuclear reactor under all thermal and hydraulic conditions in the reactor core region. The hold-down device is particularly applicable in reactors having stainless steel support barrels and Zircaloy guide tubes. The hold-down device of the preferred embodiment of the invention is comprised of coil springs coaxially disposed about alignment posts which extend upwardly from the top end plate of each fuel assembly. A hold-down plate is slideably mounted on the alignment posts and the coil springs are interposed, in compression, between the hold-down plate and the top end plate. In use, the coil springs bias the hold-down plate upwardly against a core alignment plate to provide a downward force on the fuel assembly. The hold-down plate may also serve as a lifting surface for the fuel assembly during fuel handling. (Official Gazette)

20356 POWER MEASURING AND FUEL LEAKAGE DETECTION SYSTEM. Weiss, H. H.; Gopal, R. (to Westinghouse Electric Corp.). US Patent 3,819,936. 25 Jun 1974. Filed Date 12 Aug 1971. 8p.

An ^{16}N reactor power measuring system is disclosed for measuring the thermal power of a nuclear reactor in the presence of fission product activity in the primary coolant. Furthermore, the system provides a fast response signal for the indication of any leaking fuel within the reactor core. (Official Gazette)

20357 DETERMINATION OF TURBULENT EXCHANGE COEFFICIENTS IN A ROD BUNDLE. Roidt, M. (Westinghouse Research Labs., Pittsburgh); Pechersky, M. J.; Markley, R. A.; Vegter, B. J. Contract AT(11-1)-3045. J. Heat Transfer, 96: No. 2, 172-177(May 1974).

From ASME-AIChE heat transfer conference; Atlanta, GA (5 Aug 1973).

A tracer gas is injected into a single subchannel of a large air flow model of a reactor rod bundle. Axial variations in the tracer flux are determined by sampling at two downstream positions in both the injection subchannel and those adjacent to it. This information, with measured subchannel area changes, is used to calculate crossflows and the turbulent eddy diffusion coefficient. The latter number agrees with the results of other investigators in regular pipe flows. Also determined are distributional factors which would be required for modeling the transport equations, for this particular scalar distribution, with a typical lumped parameter computer code. (auth)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstract 20442.

20358 (ANS-RPD-4, pp 63-80) SPACE-ENERGY DEPENDENT PHYSICS PROBLEMS OF PLUTONIUM FUELS IN HTGR'S. Asmussen, K. E.; Waelti, P. (Gulf General Atomic Co., San Diego, CA). [nd].

From proceedings on physics of plutonium recycle; Miami, Florida, USA (Oct 1971).

In special session of invited papers on physics of plutonium recycle.

The space and energy dependent physics problems associated with the nuclear design of a plutonium-bearing test element for irradiation in the Peach Bottom HTGR are discussed. (auth)

20359 (CEA-CONF-2565) ANALYSIS OF THE BEHAVIOR OF ELEMENTS OF THE PRIMARY CIRCUIT OF THE CHINON 2 AND CHINON 3 REACTORS UNDER THE ACTION OF STATIC AND DYNAMIC STRESSES EXERTED BY CO_2 UNDER PRESSURE. Michel, L.; Baylac, G.; Leboulanger, R.; Copin, A.; Roche, R.; Vrillon, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). Apr 1973. 13p. (In French). (CONF-730942-4). Dep. NTIS (US Sales Only) $4.00.

From second international conference on structural mechanics in reactor technology; Berlin, F. R. Germany (10 Sep 1973).

After several years of operation it is apparent that some deflecting vanes welded in the bends of the high temperature and high pressure primary circuit of the Chinon-2 and Chinon-3 reactors have ruptures and fissures. It was necessary to undertake a complete study of the permanent and fluctuating charges exerted by the flow in order to determine the possible causes of these ruptures (mechanical stresses and uncoupling instability) and to attempt to find solutions. It was concluded that the ruptures on the vane grids can be attributed to the concentration of the traction efforts at the level of imperfectly penetrated welds. Vibrations seem to play a secondary role. New grid designs are proposed to alleviate or eliminate the problem. (JSR)

20360 (IEA-20) HIGH TEMPERATURE GAS-COOLED REACTOR. da Costa, J. R. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Jan 1972. 106p. (In Portuguese). Dep. NTIS (U. S. Sales Only) $8.50.

An introductory course to the technology of HTGR is presented. The evolution of the technology of this reactor type is outlined. The basic concepts and philosophy of the high temperature gas cooled reactor are discussed. The commercial designs offered by American contractors and their most important parameters are considered. The characteristics of the prestressed concrete reactor vessel for the HTGR are examined. The characteristics of the gas cooled fast breeder are discussed. (JSR)

20361 (ORNL-TM-4397) IRRADIATION TEST OF CANDIDATE HTGR RECYCLE FUELS IN THE H-1 AND H-2 CAPSULES. Oistad, R. A.; Olsen, A. R.; Fitts, R. B.; Long, E. L. Jr.; Lindemer, T. B. (Oak Ridge National Lab., Tenn. (USA)). Jul 1974. Contract W-7405-eng-26. 62p. Dep. NTIS $5.45.

Coated HTGR fuel particles were irradiated under severe thermal conditions to high fast fluences (2 to 6×10^{21} neutrons/cm^2, >0.18 MeV) and burnups (25 to 45% uranium burnup, <1% thorium burnup) in the ETR in the H-1 and H-2 capsule irradiation test from May 1971 to May 1972. The test was designed to provide samples of irradiated fuel rods for head-end reprocessing studies and to give an accelerated irradiation of the reference recycle fuel particles that are currently being irradiated in the Peach Bottom Reactor in the Recycle Test Element series. Bonded rods of Biso-coated UO_2, (4.1 Th,U)O_2, (2.2 Th,U)O_2 or uranium-loaded strong-acid ion-exchange-resin particles mixed with Biso-coated ThO_2 particles and rods of Triso-coated UC_2 mixed with Biso-coated ThC_2 particles were irradiated. The initial fissile isotope was ^{235}U in all samples. The coated particles were bonded in a close-packed configuration with a carbonaceous matrix to form rods approximately ½ in. in diameter × 2 in. long. Each capsule was surrounded by a hafnium sleeve to decrease the thermal flux in the fuel. About half the samples operated at much above design temperatures during the last of the four irradiation cycles because the capsules were inadvertently irradiated in an inverted position during this period. The calculated center-line temperatures of the bonded rods varied from 900 to 1500°C at the beginning of the test and from 600 to 2600°C at the beginning of the last cycle. Postirradiation examination showed that the rods that operated at normal temperatures throughout the test were largely fragmented or debonded, possibly because of high thermal gradients or because of repeated thermal cycling during the test. The particles themselves survived the irradiation in excellent condition. A small amount of kernel migration was observed in UO_2, (4.1 Th, U)O_2, and (2.2 Th, U)O_2 particles in normal-temperature rods but was not observed in the ThO_2 particles. The rods that operated at very high temperatures during the last cycle were severely damaged and contained a central region of reddish powder with no recognizable particles remaining. Substantial migration of the mixed oxide and UO_2 kernels as well as the ThO_2 kernels was observed. None of the carbide or resin-derived particles have been examined metallographically at the time of writing. (auth)

20362 PROBLEMS OF MATERIALS FOR HTGR. Suzuki, H. (Tokyo Inst. of Tech.). Genshiryoku Kogyo; 19: No. 8, 25-33(Aug 1973). (In Japanese).

The problems of design, conditions of application, testing methods, quality control, and process control of the materials for HTGRs are studied at a higher temperature than 1,000°C at the outlet of helium gas in iron manufacture. Coated particle fuel (cpf), graphite, heat-resisting alloys, and heat-insulating walls and materials are reviewed. Measuring instruments such as x-ray microscopic radiograph, measuring and monitering devices using gamma rays for the average thickness of coating layer, and testing methods for the anisotropy of the pyrocarbon coating are also reviewed. The purity, nuclear functions, thermal conductivity, mechanical strength, dimensional stability, thermal shock and thermal fatigue strength, and helium corrosion resistance are described with respect to the graphite for bonding cpf and sleeves. Reflective metals, metallic gauzes, fibrous ceramics, and the like are used as the insulating walls and materials for protecting concrete. For the insulating material at a higher temperature than that of C class, it is desirable to develop the stable crystalline insulating materials having high melting point, for example Si_3N_4, Al_2O_3, ZrO_2, SiC, and C. In conclusion, it is necessary to develop the insulating walls with required and economical properties by studying on construction and method of working, and the preparation of means and apparatuses is a major problem because sufficient testing must be finished prior to use. (JA)

20363 PERMISSIBILITY OF BOILING IN DOWNCOMERS OF A CIRCULATION LOOP OF A WATER COOLED REACTOR. Bordarenko, A. V.; Minashin, M. E. Sov. At. Energy (Engl. Transl.); 35: No. 3, 840-842(Sep 1973).

Translated from At. Energy (USSR); 35: No. 3, 198-200(Sep 1973).

A calculational method is used to estimate the possible criteria for permissibility of boiling in the heating sections of coolant channel downcomers in LWGR type reactors. (DG)

20364 BILIBIN ATOMIC POWER STATION. Abramov, V. M.; Bondarenko, A. V.; Vaimugin, A. A.; Gurevich, L. V.; Dolgov, V. V.; Komissarov, O. V.; Minashin, M. E.; Nikolenko, P. A.; Simonyan, A. L.; Sosenkov, G. A.; Stepel'tsov, E. I.; Suvorov, A. I.; Kharizomenov, Yu. V.; Sharapov, V. N. At. Energ. (USSR); 35: No. 5, 299-304(Nov 1973). (In Russian).

The Bilibin Atomic Power Station, the first Soviet nuclear heat and power plant in the Arctic Circle, is described. The total electric capacity of the plant is equal to 48 MW, and heat output in the form of hot water is about 100 Gcal/hr. The distinguishing feature of the atomic power plant is natural circulation of the coolant. The nuclear reactors are of a channel graphite-water type with tubular fuel elements. (auth)

20365 PROCESS FOR OPERATING A GAS-COOLED NUCLEAR REACTOR WITH A STANDPIPE PLUG HAVING COOLANT FLOW THERE THROUGH. Stracke, W. (to Brown Boveri and Co. Ltd.). US Patent 3,816,244. 11 Jun 1974. Priority Date 15 Oct 1971, Switzerland. 4p.

A method is described for operating a gas-cooled nuclear reactor which is refuelled through the opened standpipe located in the reactor vessel. The standpipe and plug are provided with a cooling system and the plug accommodates the control-rod drive and incorporates a guide tube through which the control rod can be introduced into and withdrawn from the reactor core. The plug is supported with cold gas corresponding to the cooling gas of the reactor, such that a primary flow ("a") of cold gas removes heat from the plug and a secondary flow ("b") of cold gas removes heat from the control rod guide system and both flows are passed to the reactor core. The pressures of the primary ("a") and secondary ("b") flows are at least as high as is the highest gas pressures in the reactor core. (Official Gazette)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstracts 20343 and 20444.

20366 POSITIONING SYSTEM FOR ATR REFUELING MACHINE. Yokota, M. (Fuji Electric Co. Ltd., Tokyo); Yajima, I. Fuji Jiho; 46: No. 10, 885-888(Oct 1973). (In Japanese).

The positioning system used in fuel charging or discharging from pressure tubes in a calandria of the prototype JATR is described. The tubes are arranged in a regular lattice array, but due to the conditions in the reactor, tube ends are dislocated. Determination of the deviation of the snout of the refuelling machine from the tube end then becomes important. This is measured as a relative displacement by means of an induction coil. Four sensors on the top of the snout, two opposing to each other, surround the end of a pressure tube in fuel-exchange positioning. The sensors consist of ferrite cores wound with copper wires, so the change in lines of magnetic force due to the magnetic substance of the tube is utilized. In the arrangement of the sensors, one faces the other diagonally, and the detection of relative displacement is by zero-method using the sensors differentially. (JA)

Power Reactors, Breeding

Refer also to abstracts 19149, 20343, 20427, 20428, 20438, 20439, 20445, 20449, 20450, 20454, 20494, and 20495.

20367 (AI-AEC-13125) SODIUM TECHNOLOGY AND COVER GAS SEAL DEVELOPMENT PROGRAMS. Quarterly Technical Progress Report, January-March 1974. (Atomics International Div., Canoga Park, Calif. (USA)). 15 May 1974. Contract AT(04-3)-824. 117p. AT.

Progress made in the development and testing of techniques and procedures for the cleaning, storage, and requalification of LMFBR coolant loop components is reported. Friction test data on FFTF materials are presented. The testing of cover gas seals for LMFBR and FFTF cooling systems is described. (DG)

20368 (CONF-721237-) PROCEEDINGS OF THE INDO-SOVIET SEMINAR ON FAST REACTORS, REACTOR RESEARCH CENTRE, KALPAKKAM, DECEMBER 6-8, 1972. (Department of Atomic Energy, Bombay (India)). 1972. 526p.

Information is presented concerning the BOR-60 reactor, the Kalpakkam LMFBR reactor, PURNIMA critical facility, BFS critical facility, fast reactor safety analysis, critical assemblies, and resonance cross sections and Doppler effect. Separate abstracts are included for 32 of the 33 papers presented. One paper has been previously abstracted and included in NSA Volume 27 under abstract number 16495. (DCC)

For abstracts of individual papers see: 20369-20376, 20391-20404, 20426, 20427, 20458-20463, 20494, and 20495.

20369 (CONF-721237-, pp 25-39) INVESTIGATION OF THE SPATIAL DISTRIBUTION OF ENERGY RELEASE IN THE CORE OF BOR-60 REACTOR. Gryazev, V. M.; Inchagov, A. V.; Leshchenko, Yu. M.; Nigmatullin, N. R.; Fofanov, V. S.; Khilenko, S. N. 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

The experimental results are given of the measurements of the spatial distribution of energy release in the core of BOR-60 reactor. At the centre of the core, the absolute values of the numbers of ^{235}U (n,f), ^{238}U (n,f), and ^{238}U (n,γ) processes as well as the values of the ratio of the cross sections (special indices) averaged over the spectrum at the measurement point are determined. The experimental results are compared with the calculated ones. 8 references. (auth)

20370 (CONF-721237-, pp 41-53) EXPERIENCE IN INSTALLATION AND START-UP OF THE REACTOR BOR-60. Leipunskii, A. I.; Kazachkovskii, O. D.; Baturov, B. B. 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

Problems involved in the installation, start-up, and adjustment operations for the BOR-60 reactor are discussed. 4 references. (auth)

20371 (CONF-721237-, pp 87-117) STUDIES OF THE TEMPERATURE DISTRIBUTION IN THE CORE OF BOR-60 REACTOR. Kazachkovskii, O. D.; Antipin, G. K.; Gryazev, V. M. 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

The investigations have been carried out of temperature distributions and coolant flow rates in BOR-60 core assemblies. The form factors of temperature distributions in the core and permissible reactor power levels with the present reactor charge have been determined. 3 references. (auth)

20372 (CONF-721237-, pp 119-129) EXPERIMENTAL STUDIES ON THE DISTRIBUTION OF RADIOACTIVITY IN BOR-60 ATOMIC POWER STATION. Gryazev, V. M.; Konyashov, V. V.; Kobzar, I. G.; Lisitsyn, E. S.; Polyakov, V. I.; Poznyak, G. I.; Chechetkin, Yu. V. 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

Radioisotopic composition of sodium coolant and gas in the cover gas of the reactor and pump is analyzed. Activity of the short-lived isotopes during the reactor operation is determined. It is shown that when the reactor operated with leak-proof fuel elements, radioactivity of the coolant after the shutdown is de-

termined by the activation of sodium and the impurities in it (silver, zinc, rubidium). Radioactivity of the elements of the structural materials is small. Radioactivity of the fission fragments when burnup reaches 5.9% is not noticed. Change in the activity of the radioisotopes with time is examined. Using the experimentally determined radioisotopic composition of noble gases, probabilities of their leakage from the coolant are calculated. It is shown that for leakproof core, the average period the noble gases remain in the coolant is identical and is about 8 hours. (auth)

20373 (CONF-721237-, pp 131-147) RADIOACTIVE CONDITIONS IN BOR-60 DURING ITS TWO YEARS OF OPERATION. Kobzar, I. G.; Konyashov, V. V.; Polyakov, V. I.; Rybakov, V. N.; Chechetkin, Yu. V. (Scientific Research Inst. of Atomic Reactors, Melekess, USSR). 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

The analysis is given of the radioactive conditions in BOR-60 reactor during its two years of operation, extent of the radiation and special monitoring as well as the activity of the coolant and the effluent gas from the reactor. Gamma radiation levels in the working areas are given. It has been shown that during the operation of the reactor and while carrying out the planned-maintenance work, the radiation fields of the equipment are due to the activation products of the sodium coolant and the impurities; their radiation dose to which 99% of the staff was likely to be exposed did not exceed 0.5 rem per year; the gaseous and aerosol activity in the atmosphere of the working areas was not noticed; surface contamination was almost absent which can be decontaminated by means of simple methods. The gaseous discharge from the reactor into the atmosphere through the exhaust system is maximum of 13 curies per day, which is due to the activation of the air, cooling the biological shield of the reactor. The planned radiation and special monitoring system fully ensures the safe working conditions for the staff. (auth)

20374 (CONF-721237-, pp 149-161) EXPERIMENTAL STUDY OF NUCLEAR SAFETY PROBLEMS IN THE BOR-60 ATOMIC POWER PLANT. Gryazev, V. M.; Kobzar, I. G.; Konyashov, V. V.; Polyakov, V. I.; Chechetkin, Yu. V. (Scientific Research Inst. of Atomic Reactors, Dimitrovgrad, USSR). 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

The analysis has been carried out of the radioisotopic composition of sodium coolant and cover gas in the reactor and pumps. The change in radioisotope activities with time has been considered. The constants have been calculated for the radioactive noble gas release from coolant into cover gas. The radiation conditions are considered. The gamma-field levels in the personnel's rooms are presented as well as the results of the reactor gas release analyses. The investigation results are given of the high temperature sodium ejection into the process rooms with natural atmosphere and ventilation. Different means and methods are considered for sodium burning suppression. It is shown that the quantities of burning products released into the environmental atmosphere depend on the material of the pipeline thermal isolation. (auth)

20375 (CONF-721237-, pp 181-201) SOME PROBLEMS OF ACHIEVING SAFE OPERATION OF BOR-60 REACTOR. Kazachkovskii, O. D.; Gryazev, V. M.; Krasnoyarov, N. V.; Kevrolev, V. P.; Afanasiev, V. A.; Smirnov, A. M.; Kondrat'ev, V. I. (Scientific Research Inst. for Atomic Reactors, Dimitrovgrad, USSR). 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

The results of the investigation of the effects of the steady-state reactivity, natural circulation regimes, emergency cooling and the transients during scram system trip are presented. The description is given of the changes in the systems and the technological process; and the operational reliability of the equipment and the reactor systems is verified. (3 references) (auth)

20376 (CONF-721237-, pp 203-220) CALCULATIONAL STUDIES FOR DETERMINING THE CRITICAL PARAMETERS OF BOR REACTOR. Leipunskii, A. I.; Orolov, V. V.; Troyanov, M. F.; Matveev, V. I.; Chernyi, V. A.; Novozhilov, A. I.; Pshakin, G. M.; Zhukov, A. V.; Shagalin, N. M. (Physics and Power Inst., Obninsk, USSR). 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

The results are given of the analysis of the critical parameters and the fields of heat release in BOR reactor. Problems are discussed relating to the choice of the calculation method and the calculation model of the reactor. Calculations are effected for various states of the reactor in two dimensional and three dimensional geometries. Considering the latest changes in the nuclear data, the calculated results are compared with experimental ones that have been obtained on the critical assembly BFS-21, the mock-up of BOR reactor. Based on the experimental data, improvements have been effected in the reactor characteristics. (11 references) (auth)

20377 (COO-2245-8) COOLANT MIXING IN LMFBR ROD BUNDLES. Quarterly Progress Report, December 1, 1973–February 28, 1974. Todreas, N. E. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 1974. Contract AT(11-1)-2245. 50p. AT.

Progress is reported on the development of analytical models and measuring equipment and methods for studying coolant mixing in LMFBR channels and in assessing available hydraulic test data on such mixing. (DG)

20378 (EURFNR-1148) CALCULATION OF NEUTRON FLUX IN OUTER CORE AND BLANKET REGIONS OF FAST REACTORS. Lalovic, M. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Nov 1973. 129p. Dep. NTIS $9.50.

Worked performed under United States–Euratom fast reactor exchange program.

Thesis.

The effort needed to calculate neutron flux in outer core and blanket regions of fast reactor assemblies to sufficient accuracy is investigated. The following questions are considered from the standpoint of diffusion: (1) Is experience concerning the number of space mesh points used in the core-calculations also appropriate to the blanket? (2) How many weighting spectra are necessary to construct zone-dependent group constants for the blanket region? (3) What is the role of the fine structure in the weighting of group constants? The effect of considering transport theory in calculating the neutron flux in outer core and blanket regions will be determined by comparison of S_N and diffusion calculations. To check the reliability of the S_N results, they are compared with independent Monte Carlo methods of transport theory. The influence of reflector on the neutron flux in outer regions will be studied. For the object of these studies a model of a 300 MW(e) sodium-cooled fast reactor (SNR) was chosen. Furthermore, the possibility of simulating core and blanket regions of a fast reactor in a subcritical assembly with an external source will be tested. (auth)

20379 (EURFNR-1151) UO_2-PuO_2 FUEL PIN IRRADIATION IN TREFOIL INSERT DFR-304. Evaluation of the Investigation Results on Irradiated Fuel Rods. Ehrlich, K.; Goetzmann, O.; Hoffmann, H.; Kleykamp, H.; Zimmermann, H.; Dienst, W. (comps.). (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Material- und Festkoerperforschung). Jan 1974. 96p. Dep. NTIS $5.45.

Work performed under United States–Euratom fast reactor exchange program.

In the irradiation test DFR-304, three UO_2–PuO_2 fuel pins (360 mm fuel length) were irradiated in a so-called trefoil cooled by flowing NaK. Irradiation was performed in the fast neutron flux of the test reactor DFR (Dounreay) at rod powers between about 380 W/cm (fuel end) and 500 W/cm (neutron flux maximum) to a maximum burnup of 6.3 at. % (U + Pu). The maximum fuel temperature was possibly above 2800°C in the beginning and about 2500°C after formation of the central hole. The cladding i.d. temperature was between 320°C and 700°C (at the cooler end and at the hot end of the fuel pin). The amount of fission gas was measured in three steps as released gas, as gas retained in large bubbles, and as gas retained in small bubbles and crystal lattice sites. The evaluation of the retained fission gas distribution over the fuel length resulted in a strong temperature dependence of fission gas retention at low fuel temperature <1300°C. From microstructure examination on fuel pin cross-sections, the temperature limit of columnar grain growth was found to be at 1680 to 1760°C fuel irradiation temperature. The temperature limit for equiaxed grain growth was about 1300°C. The void volume distribution in fuel pin cross-sections was examined by measuring gap widths, cracks widths, central hole diameters, and porosity. Electron microprobe analysis was applied to examine plutonium redistribution, fission-product compound composition and distribution, and cladding corrosion. Redistribution of uranium and plutonium in the radial fuel temperature gradient resulted in Pu-enrichment around the central void amounting to 22% PuO_2 (compared to 20% original) at the hot bottom end of the fuel column. The chemical reaction between fuel and cladding was most strongly marked in the vicinity of the fuel/blanket contact, which possibly yields a locally accelerated oxygen transport from the central void to the cladding. No corrosion attack by the NaK-coolant could be indicated on the cladding surface. The examination of micrographs from fuel pin cross-sections showed considerable penetration depths of the cladding inside attack only above 550°C (cladding i.d. temperature). A 16 Cr–13Ni–niobium

stabilized stainless steel (type 1.4988) was irradiated as fuel pin cladding. The irradiation temperature ranged from 300 to 650°C. Neutron fluences from 3.3 to 4.0 $n/cm^2 \times 10^{22}$ ($E > 0.1$ MeV) were achieved. Swelling behavior of the cladding material was studied by transmission electron microscopy, immersion density determinations and diametral change measurements. Void formation was observed in the temperature range 360–610°C. Swelling in type 1.4988 was found to be lower than that reported for AISI 316 at higher temperatures. The measured diameter changes of the pins at $T \geq 610$°C cannot be explained by void formation. (auth)

20380 PROGRESS TOWARD THE COMMERICAL LMFBR. Murray, P.; Dyos, M. W. Combustion; 45: No. 12, 26-29(Jun 1974).

From American power conference; Chicago, IL (29 Apr 1974).

The necessary steps in achieving a commercially viable LMFBR system are considered by addressing individually the questions of: (1) How does the industry proceed from the technology of the Fast Flux Test Facility and the Clinch River Breeder Reactor Project to a commercially viable industry? (2) What should be the basis for the design of the next LMFBR plant, and what are its prospects for economy? (3) How should the safety activities for LMFBRs be directed to insure rapid licensing? In the discussion of these questions, particular emphasis is placed on objectives that can lead to achieving minimum capital costs for commericial size LMFBRs. (auth)

20381 STEAM GENERATOR TEST LOOP FOR SODIUM COOLED FAST BREEDER REACTOR. Ishikawajima-Harima Giho; 14: No. 1, 66-77(Jan 1974). (In Japanese).

In the development of the liquid metal fast breeder reactor (LMFBR), the steam generator (SG) is considered a component which requires preferential development. In Japan, the helical coiled heat transfer tube type SG was chosen as one of the SG types for the LMFBR, and research and development will proceed. However, this type possesses some problems to be solved, such as boiling in the downcomer and multi-channel flow instability during low load operation. A test loop was designed and manufactured for the purpose of proving thermal and hydrodynamic performance and obtaining basic experimental data for the problems mentioned above. The SG installed in this loop is provided with three helical coiled heat transfer tubes (19.0 mm O. D. × 3.2 mm t × 25.0 m *l* for heat transfer section) with a heat transfer capacity of about 0.2 MWt. The preoperation data was confirmed under actual operating conditions (steam condition: 132 kg/cm^2g × 487°C, 0.32 t/h) as was expected. (auth)

20382 CONSTRUCTION OF THE EXCHANGERS AND STEAM GENERATORS OF THE FAST NEUTRON PLANT, PHENIX. Tech. Mod.; No. 3, 49-50(Mar 1974). (In French).

A brief review is given on the fabrication and operation of the intermediate heat exchangers and steam generators of the Phenix fast reactor. (FR)

20383 THERMAL SHOCK TESTING MODEL OF IHX USED FOR PROTOTYPE FBR PLANT "MONJU". (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo). Ishikawajima-Harima Giho; 14: No. 2, 169-177(Mar 1974). (In Japanese).

Generally, the various vessels and heat exchangers constructed for the Fast Breeder Reactor (FBR) plants are subjected to very severe thermal shock, since these components handle high temperature liquid sodium. The Intermediate Heat Exchanger (IHX), a main component of the FBR plant, has a large thickness and complex structure for the tube sheet, and thermal studies are important in the IHX design. A scale model has been made of the tube sheet of the IHX of MONJU, a prototype FBR plant in Japan. The results of the test that will be performed by the Power Reactor and Nuclear Fuel Development Corporation (PNC) are expected to clarify the aspect of thermal shock acting on the tube sheet of the actual IHX. The following problems were considered in the design and fabrication of the model: (1) design criteria of the component subjected to severe thermal shock, (2) thermal strain measuring method in high temperature liquid sodium, (3) tube sheet machining technique, (4) tube-to-tube sheet welding technique, and (5) nondestructive examination technique. (auth)

20384 PROBLEMS ENCOUNTERED IN CENTRIFUGAL PUMPS AND MECHANISMS OPERATING WITH HOT SODIUM AND ARGON. Guer, M. (SNECMA, Suresnes, France). Mecan. Mater. Elec.; No. 290, 16-19(Feb 1974). (In French).

Problems encountered in pumps operating with sodium are presented. The development of the following pumps is discussed: a highly leakproof machine with a jacketed electric motor having a rotor rotating in water; a sheathed machine in which the spindle rotating the wheel extends from the machine through a rotating joint; a free level vertical axis machine, the pump of which is suspended by a structure maintaining it submerged in a vessel partially filled with sodium, the gas phase above the free-level consisting of argon. The development of these pumps greatly facilitated the construction of machines for the primary manipulation of fast reactor fuel elements. (FR)

20385 PROTOTYPE FAST NEUTRON REACTOR, PHENIX. Carle, R. (CEN de Saclay, Gif-sur-Yvette, France). Develop. Ind. Sci.; No. 18, 23-25(Jan 1974). (In French).

The characteristics of the Phenix reactor are reviewed together with the problems encountered during its development. Emphasis is given to the large number of tests carried out before its construction and before it became operational. (FR)

20386 THERMAL-HYDRAULIC PERFORMANCE OF A 2 MW(t) SODIUM-HEATED FORCED RECIRCULATION STEAM GENERATOR MODEL. Hunsbedt, A.; Roberts, J. M. (General Electric Co., Sunnyvale, CA). J. Eng. Power; 96: No. 1, 66-76 (Jan 1974).

From Joint Power Generation Conference; New Orleans, LA (16 Sep 1973).

The results of LMFBR (Liquid Metal Fast Breeder Reactor) steam generator model tests conducted in a 2 MW(t) sodium-heated test facility at prototypical Breeder Reactor Demonstration Plant conditions are presented. Included are heat transfer performance data and a sodium-side heat transfer correlation for a seven-tube bayonet tube forced recirculation evaporator with identical tube geometry to a proposed LMFBR Demonstration Plant evaporator. The departure from nucleate boiling characteristic of the bayonet tubes employing swirl flow generators and the steam-side heat transfer coefficients in the transition boiling regime were measured. The steam-side boiling stability characteristics of the evaporator were evaluated and a summary of the results are presented. The results also include heat transfer performance data for a helical coil superheater containing two active tubes and one inactive tube. Sodium temperature distribution data for the evaporator measured at various load conditions indicating steep axial temperature gradients in the sodium inlet plenum region are presented along with sodium temperature distribution data for the superheater. Finally, sodium-side instability data associated with series operation of the models, both containing cover gas spaces, are presented along with sodium temperature fluctuation data measured in the inlet plenum of the evaporator. (auth)

20387 GAS-COOLED FAST REACTORS. A Review. Arch. Energiewirtsch.; 28: No. 5, 246-255(Mar 1974). (In German).

Also published in the Journal of the British Nuclear Society.

A review is given of the present state of development of gas-cooled fast reactors. Main emphasis lies on fuel and coolant technology, reactor design and reactor safety. (GE)

20388 PRESSURE VESSEL. Rajakovics, G. (to Gebr. Boehler and Co. AG.). US Patent 3,822,186. 2 Jul 1974. Priority Date 21 Aug 1970, Austria. 4p.

An inner container has an inner bottom and defines an inner space and is adapted to hold a liquid coolant in the inner space to a predetermined level. An outer container contains the inner container and has an outer bottom spaced below the inner bottom. The outer container defines with the inner container an outer space extending below and around the inner container. A solid heat-insulating layer extends in the outer space below and around the inner container and upwardly at least to a predetermined level. (Official Gazette)

20389 TOP SHIELD SEALING SYSTEM OF A NUCLEAR REACTOR. Thorel, J. P.; McEdwards, J. A. (to Rockwell International Corp.). US Patent 3,819,478. 25 Jun 1974. Filed Date 24 Nov 1971. 10p.

The top shield of a typical fast breeder reactor contains one or more rotatable plugs, the rotatable plugs being separated from the coolant liquid by an annulus adjacent the plug. Two dip seals using liquid sodium in a trough are used in series to seal the primary coolant and cover gas from the top shield annuli. A third dip seal in series with the first two uses a low melting point alloy frozen during normal reactor operation to seal the reactor core cover gas from the operating floor atmosphere. (Official Gazette)

Research, Test, and Experimental Reactors

Refer also to abstracts 20367, 20368, 20423, 20426, and 20459.

20390 (ANL-8086) KINETICS RESEARCH AND TESTING / T EBR-II. Larson, H. A. (Argonne National Lab., Ill. (USA)). Apr 1974. Contract W-31-109-Eng-38. 37p. AT.

Rod-drop or rod-oscillator experiments, or both, have been done at EBR-II during its entire history of operation. A historical review and description of these devices is presented, along with the

analysis procedure used on each. Tables of parameters for the rod-drop curve fits are provided. Special experiments show reproducibility of rod-drop tests and indicate the sensitivity of the curve-fitting procedure. Both noise and feedback reactivity decrease with increasing rod-bank position. Feedback-reactivity comparisons are made as determined by rod-drop and rod-oscillator experiments. From several rod-oscillator tests, a gross system time constant was found. Also discussed are possible devices used to measure reactor response, and advantages and disadvantages of the various devices. (auth)

20391 (CONF-721237-, pp 55-65) METHODS OF CALCULATION USED IN THE NEUTRONICS DESIGN OF FBTR. Shankar Singh, R.; Lee, S. M. (Reactor Research Centre, Kalpakkam, India). 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

FBTR is a 40 MW(t) sodium cooled test fast reactor using mixed oxides of plutonium and uranium as fuel, nickel as reflector and thorium dioxides as blanket. The computer codes and cross-section libraries used for some of the physics design calculations performed for this reactor are described. The method of approach to the calculational problems and the approximations made are explained, though details of the numerical techniques used are not elaborated. Multigroup diffusion theory has been used for these calculations. The cross section set used is the Cadarache 25 group Version 1 library. The methods used and the approximations made in the preparation of this library from the point data is outlined and then the one dimensional and two dimensional criticality calculations are described. (auth)

20392 (CONF-721237-, pp 67-86) DIFFUSION STUDIES IN THE COVER GAS OF FBTR. Ganesan, S.; Shankar Singh, R. (Reactor Research Centre, Kalpakkam, India). 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

To see the possibility of using argon gas to prevent the deposition of sodium vapor to in rotating plugs and other upper parts of the reactor vessel, diffusion studies of the gases involved under certain static and dynamic conditions have been made. After discussing the effects of thermal diffusion and that of diffusion under gravitational influence, the effects of continuous injection of argon at the top of the vessel and the equal amount of continuous ejection of argon gas at certain other planes of the vessel have been studied in one dimensional mathematical formulation. It is concluded that the argon gas can be used to serve the purpose which helium served but the rate of continuous injection and ejection turns out to be around 4 times the rate of injection of helium. (auth)

20393 (CONF-721237-, pp 163-180) CONTROL OF LEAKPROOFNESS OF THE FUEL ELEMENTS IN THE REACTOR BR-5. Efimov, I. A. (Fiziko-Energeticheskii Institut, Obninsk, USSR). 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

The necessity of the control system for the leakproofness of the claddings and the detection system for faulty sub-assemblies in sodium cooled fast neutron reactors is justified. Description of some of the characteristics of the fission product yield from faulty plutonium dioxide and uranium monocarbide fuel elements is given, which have been noticed in the reactor BR-5. Results are given of the experiments on the study of the leakage of gaseous fission products from the fuel elements, conditions of the degassing of sodium, problems of the purification of the gas from sodium vapors and volatile fission products. Results are also given of the tests for the leakproofness of fuel elements in the shut-down reactor. (11 references) (auth)

20394 (CONF-721237-, pp 237-248) ZERO ENERGY FAST REACTOR AT TROMBAY. Iyengar, P. K.; Srinivasan, M.; Nargundkar, V. R.; Subba Rao, K.; Chandramoleswar, K.; Kapil, S. K.; Pethe, V. A.; Seshadri, S. N.; Ray, A. K.; Krishnamurthy, T. N. (Bhabha Atomic Research Centre, Bombay). 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

Design characteristics, control system, and experimental facilities of the PURNIMA reactor are described. (DCC)

20395 (CONF-721237-, pp 249-268) PURNIMA FAST CRITICAL FACILITY: EXPERIMENTS AND RESULTS. Iyengar, P. K.; Srinivasan, M.; Nargundkar, V. R.; Chandramoleswar, K.; Subba Rao, K.; Pasupathy, C. S.; Das, S.; Basu, T. K.; Job, P. K. 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

Reactor kinetics and experimental studies performed in the PURNIMA reactor are reviewed. (DCC)

20396 (CONF-721237-, pp 269-279) MEASUREMENT OF THE NEUTRON SPECTRA ON THE BFS STAND. Belov, C. P.; Dulin, V. A.; Efimenko, V. F.; Kazanskii, Yu. A.; Kuzin, E. N.; Lutyaev, V. M.; Shapar, A. V. (Physics and Power Inst., Obninsk, USSR). 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

Neutron spectrum is measured on the BFS Assembly by means of three spectrometers, such as time-of-flight spectrometer, hydrogen proportional counter spectrometer and organic crystal scintillation counter spectrometer. A brief description is given of the spectrometers and the methods for processing the experimental data. Results are given of the initial measurements of the neutron spectra and their comparison with the calculations. (4 references) (auth)

20397 (CONF-721237-, pp 281-292) ANALYSIS OF THE RESULTS OF CERTAIN INTEGRAL EXPERIMENTS ON THE BFS-23 ASSEMBLIES. Voroshaev, A. I.; Dulin, V. A.; Kazanskii, Yu. A.; Koloskov, B. V.; Mamontov, V. F.; Sidorov, G. I. 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

The ratios of the average cross-sections of the fissile elements and absorbers as well as the ratios of the central reactivity worths of the same elements have been studied on the BFS fast assemblies, which are mock-up of fast power reactor with sodium coolant and fuel ^{235}U (BFS-22) and plutonium-239 (BFS-23). The results have been compared with 26-group calculations in P_1 approximation according to the ABBN-70 constant system. The comparison makes it possible to conclude that the calculated neutron spectrum is somewhat harder than the actual spectrum of the facility, and the calculated importance in the energy range of fission spectrum is too high. Some possible factors responsible for such a deviation are discussed. (4 references) (auth)

20398 (CONF-721237-, pp 293-305) STUDY OF THE HETEROGENEITY EFFECT IN BFS-26 ASSEMBLY. Dulin, V. A.; Voropaev, A. I.; Kazanskii, Yu. A.; Mamontov, V. F.; Sidorov, G. I. (Physics and Power Inst., Obninsk, USSR). 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

The assembly with central insert has been assembled at BFS stand, where there was a possibility of assembling homogeneous and heterogeneous cells for studying the effect of heterogeneity of the cells on the value of the ratios of the cross-sections and central coefficients of reactivity of the samples. The experimental data obtained are compared with the calculation. (7 references) (auth)

20399 (CONF-721237-, pp 337-356) EXPERIMENTAL STUDIES ON THE CRITICAL ASSEMBLY KBR-1. Golubev, V. I.; Golyaev, N. D.; Goncharov, R. K.; Zvonarev, A. V.; Isachin, S. I.; Kindinov, P. V.; Kozlovtsev, V. G.; Morozov, I. G.; Savoskin, N. M.; Kodarev, E. A. (Physics and Power Inst., Obninsk, USSR). 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

The results obtained of the investigations carried out in the central region of the reactor COBRA which contains uranium-235, uranium oxide, graphite and steel forming the KBR-1 assembly, are given. (10 references) (auth)

20400 (CONF-721237-, pp 357-375) STUDY OF THE PHYSICS CHARACTERISTICS OF A SUBCRITICAL ASSEMBLY CONTAINING PLUTONIUM. Golubev, V. I.; Golyaev, N. D.; Zvonarev, A. V.; Kindinov, P. V.; Koleganov, Yu. F.; Savos'kin, M. M. (Physics and Power Inst., Obninsk, USSR). 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

The results of the experiments carried out in the sub-critical plutonium assembly are given. The reactor BR-1 having uranium oxide shield was used as the external neutron source. The spatial distributions of the rates of various reactions, spectral indices and the material buckling of the medium were measured. Results of the experiments are compared with the calculation. (7 references) (auth)

20401 (CONF-721237-, pp 377-387) EXPERIMENTAL PROGRAM OF THE FAST THERMAL ASSEMBLIES OF THE "SPECTRUM" SERIES TO VERIFY AND IMPROVE THE NEUTRON PHYSICS CONSTANTS FOR FAST REACTORS. Gryazev, V. M.; Gadzhiev, G. I.; Baranov, S. M.; Demidov, L. I.; Dychagin, V. N.; Shkurpelov, A. A.; Yakovleva, I. V. 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

Experimental program to verify and improve the neutron physics

constants of the main reactor materials and fission fragments from the integral experiments on fast-thermal critical assemblies "spectrum" is given. The assemblies and the samples required for ensuring the measurements in the spectrum of fast reactors are listed. Some results of the integral experiments on the assembly "spectrum-1" are described. (4 references) (auth)

20402 (CONF-721237-, pp 389-406) ANNULAR TYPE OSCILLATOR FAST REACTOR. Goncharov, R. K.; Zvonarev, A. V.; Isachin, S. I.; Kozlovtsev, V. G.; Markelov, I. P.; Morozov, I. G.; Nikolaev, M. N.; Khodarev, E. A. 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

The fast critical facility of annular type COBRA is described. The critical facility COBRA is designed for neutron-physics characteristics of large fast power reactors using mainly high sensitive oscillator technique. Brief description of critical facility and oscillator is given and requirements on critical facility and oscillator for securing small reactivity measurements ($\Delta K/K = 10^{-5}$) are considered too; expected reactivity perturbation due to introduction of various material samples into core is estimated. Some questions of forming actual neutron spectra of wide class of fast reactors depending on dimensions of central test zone are discussed. (6 references) (auth)

20403 (CONF-721237-, pp 407-415) INVESTIGATIONS OF THE PHYSICS OF FAST REACTORS WITH CRITICAL ASSEMBLIES FEI. Morozov, I. G.; Voropaev, A. I.; Dulin, V. A.; Kazanskii, Yu. A. (Physics and Power Inst., Obninsk, USSR). 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

A short description of the experimental facility of the physics and power institute is given for carrying out the investigations of the physics of fast neutron reactors. Some aspects are examined of the program of the integral experiments on "pure" assemblies for verifying and correcting the group constants for the calculations of fast neutron reactors. (14 references) (auth)

20404 (CONF-721237-, pp 471-483) STUDY OF THE DOPPLER EFFECT IN URANIUM-238 IN URANIUM OXIDE SHIELD OF THE BR-1 REACTOR. Golubev, V. I.; Golyaev, N. D.; Zvonarev, A. V.; Kindinov, P. V.; Koleganov, Yu. F.; Nikolaev, M. N.; Orlov, M. Yu. (Physics and Power Inst., Obninsk, USSR). 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

The study of the influence of the Doppler effect on the capture cross-section of uranium-238 in the uranium oxide spectrum, which has been made in the reactor BR-1, is given. Two cycles of the measurements are given: heating of the small uranium sample to 2000°K in cold medium and heating of large uranium oxide block. The experimental data are compared with the results of the calculation. (3 references) (auth)

20405 (HEDL-TME-73-54, pp ANC.6-ANC.8) CFRMF FLUX SPECTRA, POWER LEVEL, AND GRADIENT DETERMINATIONS. Millsap, D. A.; Harker, Y. D.; Rogers, J. W. (Aerojet Nuclear Co., Idaho Falls, ID). Feb 1974.

In LMFBR reaction rate and dosimetry 8th progress report for period March-September 1973.

20406 (HEDL-TME-73-54, pp ANC.9-ANC.10) CFRMF REACTION RATES FROM POWER LEVEL MONITOR FOILS. Rogers, J. W. (Aerojet Nuclear Co., Idaho Falls, ID). Feb 1974.

In LMFBR reaction rate and dosimetry 8th progress report for period March-September 1973.

20407 (INIS-mf-1310) HEAT TRANSFER ASPECTS OF APSARA REACTOR AT ELEVATED POWER LEVELS. Nath, M. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 10p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

Heat transfer aspects of the Apsara reactor were examined from the point of view of reactor operation at higher power levels. It has been found that the avoidance of nucleate boiling in any part of the core is the most proper safety criterion. In this regard, a semi-analytical treatment was carried out to investigate the magnitudes and the locations of the hottest spots on the cladding-coolant interfaces of the individual fuel plates. The analysis includes a wide range of varying operational parameters such as the core loading pattern, the reactor power and power distribution, the reactor flow and flow distribution, the nature of coolant motion (streamline or turbulent), and the mode of coolant flow (natural or forced). Depending upon the power-flow conditions in individual coolant channels, the appropriate heat transfer coefficients are used to work out the maximum cladding-coolant interface temperatures and thus the maximum reactor power. Some interesting results are brought out. (auth)

20408 (JINR-P3-7946) HIGH-FLUX REACTOR SM-2 AS AN EFFECTIVE SOURCE OF ULTRACOLD NEUTRONS. Zamyatin, Yu. S.; Kolesov, A. G.; Kulagin, E. N.; Lushchikov, V. I.; Morozov, V. I.; Nefedov, V. N.; Pokotilovskii, Yu. N.; Strelkov, A. V.; Shapiro, F. L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 16p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

A device for production of ultracold neutrons in a horizontal channel of the high-flux SM-2 reactor is described. Taking into account the efficiency of the detection method the extracted flux of ultracold neutrons was estimated ($\approx 10^3$ sec^{-1}). During 15 days of continuous operation of the reactor no noticeable decay in the yield was observed. A conclusion is drawn about the possible use of the SM-2 reactor as an effective source of ultracold neutrons. (auth)

20409 (LA-4798-MS) BARE U(93)C_{170} ASSEMBLY. Hoogterp, J. C.; Hansen, G. E.; Paxton, H. C. (Los Alamos Scientific Lab., N. Mex. (USA)). Mar 1974. Contract W-7405-eng-36. 6p. Dep. NTIS $4.00.

The "Honeycomb" critical assembly is a nominal cube of U(93.15) foil and graphite plates regularly interleaved such that the carbon-to-uranium atomic ratio is 170. The assembly description is corrected empirically to a homogeneous near-cube reflected only by a low-density aluminum matrix that extends through the core and to the outside. Critical specifications for checking calculations are given in x, y, z coordinates and in equivalent r, z coordinates. Other quantities useful as computational checkpoints are spectral indexes, typified by $\bar{\sigma}_f(\text{U-235})/\bar{\sigma}_f(\text{U-238}) = 110$, and central reactivity contributions of foil samples at various thicknesses. Effective reactivity coefficients of ^{235}U, thorium, tungsten, and molybdenum change significantly with sample thickness, whereas the reactivity coefficient of ^{235}U is essentially constant at 9.4¢/g-atom for thicknesses up to 0.028 cm. (auth)

20410 (ORNL-TM-4618) BULK SHIELDING FACILITY QUARTERLY REPORT, JANUARY-MARCH, 1974. Hurt, S. S. III.; Lance, E. D.; Thomas, J. R. (Oak Ridge National Lab., Tenn. (USA)). Jul 1974. Contract W-7405-eng-26. 20p. Dep. NTIS $4.00.

The BSR operated at an average power level of 1675 kw for 12.93% of the time during January, February and March. Water-quality control in both the reactor primary and secondary cooling systems was satisfactory. There were no unscheduled shutdowns during the quarter. The reactor remains shut down at the end of the quarter for repairs to the pool which accounted for 83.5% of the total downtime. The PCA was operated 16 days during this quarter. Nuclear engineering students from the University of Tennessee and the University of Oklahoma participated in training labs during this time. (auth)

20411 MEASUREMENT OF THE FAST NEUTRON FLUX DENSITY IN THE BULK SHIELDING EXPERIMENTAL TANK OF THE TRIGA MARK-II REACTOR USING SOLID STATE TRACK DETECTOR. Ro, S. G.; Jun, J. S.; Cho. S. H. J. Korean Nucl. Soc.; 5: No. 4, 334-338(1973).

The horizontal distribution of the fast neutron flux density in the Bulk Shielding Experimental Tank of the TRIGA Mark-II reactor at the steady power of 250 KW has been measured using a solid state track detector which is natural mica placed in contact with ^{232}Th fissile foil. The neutron flux density was calculated on the assumption that the fast neutron spectrum is similar to that form the thermal-induced ^{235}U fission. The resulting flux density distribution along the horizontal line from the center of the thermalizing column door is presented in tabular and graphical forms. (Korean Sci. Abstr.)

20412 STUDIES ON THE CORROSION RESISTANCE OF STRUCTURAL MATERIALS IN AN MR REACTOR LOOP IN THE CASE OF USE OF BORIC ACID. Chernorotov, E. S. (Inst. of Atomic Energy, Moscow). Kernenergie; 17: No. 5, 139-145(1974). (In German).

The results of studies on the corrosion resistance of structural materials in water-cooled, water-moderated reactors carried out in the PVK loop of the I. V. Kurchatov Institute of Atomic Energy MR reactor are presented. The corrosion tests, lasting over a period of 8000 hrs, showed that the corrosion rate of stainless steels in solutions of boric acid partially neutralized by alkali is less than that in water free from boric acid. The corrosion rate of pearlitic steels strongly depends on their degree of alloying. On the medium-alloyed pressure vessel steel (48TC type) a dense protective layer formed. The corrosion rate of those steels depends on the concentrations of boric acid and alkali less than that of the low-alloyed steels of CT20 type which do not form such a protective layer. The corrosion rate of the 48TC type

steels indicates their suitability for pressure vessel applications in water-cooled, water-moderated power reactors without plating with stainless steels in mixed NH_3–KOH–H_3BO_3 régime. During refuelling steady-state corrosion of low-alloyed steels can efficiently be suppressed by adding ammonia to the solutions of boric acid up to concentrations of more than 100 mg/l. (auth)

20413 INVESTIGATION OF THE NEUTRON CHARACTERISTICS OF A WWR-M REACTOR CORE. Pasechnik, V. M.; Rudik, A. F.; Krasik, Yu. I.; Lomakin, S. S.; Kulikov, V. I.; Shelenin, A. V.; Panfilov, G. G. At. Energ. (USSR); 35: No. 5, 315-316(Nov 1973). (In Russian).

Neutron fields in a WWR-M reactor core were investigated by means of small Th-232 and U-235 fission-chambers and activation detectors. The activation detectors consisted of gold, copper and cobalt foils, and alloy foils of aluminum with lutetium and europium. The measurements were performed in fuel assemblies, dry canals and water cavities of the reactor core. The relative distributions of thermal neutrons, spectral characteristics, absolute values of thermal neutron flux density and thermal neutron temperatures were determined, and the data were used to design a new core, making it possible to more effectively conduct research work on a reactor having improved operating characteristics. (auth)

Production and Materials Testing and Processing Reactors

20414 (AED-Conf-74-164-002) MULTI-PURPOSE POWER PLANTS. Korek, J. (Kraftanlagen A. G., Heidelberg (F. R. Germany)). 1974. 15p. (In German). INIS

From VDI-DKV special meeting on integrated energy supply; Hamburg, F. R. Germany (7 May 1974).

3 figs.

This survey deals with various combinations of power plants generating process heat, electricity, or heat for districting heating, and/or are using different fuels (conventional fuels/refuse). Particular emphasis is given to thermal power plants and to thermal power plants with steam turbines. (GE)

20415 THE COAL CONVERSION PROCESS OF VEW. Energiewirtsch. Tagesfragen; 24: No. 1;2, 31-32(Jan 1974). (In German).

The basic principles of a novel method are described which has been developed by VEW as an alternative to the use of oil and natural gas for the generation of energy. With this new method, gas and electricity are produced from coal, with most of the sulphur contained in the coal being separated during the degassing of the fuel, converted to elementary sulphur, molten and recovered in the form of granulated sulphur. The overall project has been designed so as to allow its realization by the end of the 1970's, and it has been proposed to initiate the construction of prototype plant without further delay. (GE)

20416 THE PROCESS VARIANTS FOR THE PRODUCTION OF IRON BY NUCLEAR ENERGY. Wenzel, W.; Block, F. R.; Stolzenberg, G. Klepzig Fachber.; 81: No. 10, 407-411(Oct 1973). (In German).

6 figs.; 18 refs.

This article deals with the use of process heat from high-temperature reactors (HTR) for chemical processes, with the Gulf General Electric reactor and the pebble bed reactor; further with the transmission of heat from the HTR to the chemical process, with direct reduction and gas reduction, the integrated and non-integrated gas reduction process, and with the electrolysis of water. (GE)

20417 PRESENT SITUATION OF THE GENERATION OF GAS FROM COAL THROUGH STEAM GASIFICATION USING THE HEAT FROM HIGH TEMPERATURE NUCLEAR REACTORS. van Heek, K. H.; Juentgen, H.; Peters, W. (Bergbau-Forschung G.m.b.H., Essen (F. R. Germany)). Erdoel Kohle; 26: No. 12, 701-703(Dec 1973). (In German).

2 figs.; 3 tabs.; 18 refs.

Through the use of process heat from gas-cooled high-temperature nuclear reactors for the endothermal steam gasification of coal and for the production of the necessary process steam it is possible to save coal as a supplier of heat and to use it only as raw materials for the produced gas. In order to be able to realize the project on a technical scale it is necessary to improve high-temperature nuclear reactors for obtaining temperatures higher than 900°C, as well as the transfer and the development of suitable gas generators. The basic idea for a gasifier is presented. The design of the gas generator based on experiments to determine the kinetics of coal gasification as well as heat transfer shows that it is possible to gasify coal on a large scale at helium temperatures exceeding 900°C. (GE)

Propulsion and Package Reactors

Refer also to abstract 20496.

20418 (BMFT-FBK-74-1) FINAL REPORT ON AN IN-CORE THERMIONIC REACTOR (TR). Volume III. Studies on the In-Core Thermionic Reactor (TR) Project (Appendix). (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). Apr 1974. 33p. (In German). Dep. NTIS (US Sales Only) $4.75.

A review of the activities of the Institut für Kernenergetik (IKE), University of Stuttgart, on thermionic reactors is presented. Special emphasis is placed on a final summary of IKE's research work within the ITR project. The subjects investigated were: reactor systems, neutron theory, radiation shielding, dynamics & control, thermionic & spectroscopy, heat transfer, technology. A detailed listing of IKE's reports and papers on thermionic reactors is given. (auth)

Reactor Safety and Environmental Aspects

Refer also to abstracts 18387, 18535, 18572, 18611, 18616, 18620, 18624–18626, 18644, 18648, 18673, 18676, 18686, and 20374.

20419 (AEC-tr-7557) FAULT TREE METHOD OF SAFETY ANALYSIS. Carnino, A. (CEA, 75 - Paris (France). Dept. de Surete Nucleaire). Jun 1974. Translation of SETS Report No. 14. 34p. Dep. NTIS $4.00.

The various stages in the fault tree method of safety analysis are discussed. A reliability study of the containment sprinkling system of the Fessenheim PWR is presented to illustrate the method. (JWR)

20420 (AED-Conf-73-660-001) MEASURES FOR PROTECTING NUCLEAR POWER PLANTS FROM EXTERNAL IMPACTS. Schnurer, H. (Bundesministerium des Innern, Bonn (F. R. Germany)). 1973. 25p. (In German). INIS.

From VGB 1973 conference on civil engineering in thermal power plants; Duesseldorf, F. R. Germany (25 Sep 1973).

Available from ZAED. Will be publ. in VGB Kraftwerkstech.

The extension of reactor safety philosophy in the German Federal Republic is described for the natural phenomenon 'earthquake' and for external impacts such as 'airplane crash', 'shock waves from chemical explosions' and 'sabotage'. (GE)

20421 (AED-Conf-74-157-010) A SYSTEM FOR CONTROLLING RADIOACTIVE SUBSTANCES RELEASED WITH WASTE WATER FROM NUCLEAR POWER STATIONS. Wolter, R. (Bundesgesundheitsamt, Berlin (F. R. Germany). Inst. fuer Wasser-, Boden- und Lufthygiene). 1974. 36p. (In German, English). INIS.

From Seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974).

11 figs.; 5 tabs.; 7 refs. With abstract.

Waste water of nuclear power stations is analyzed for γ-emitting radionuclides and the pure β-emitters Sr-90, Sr-89 and H-3. The use of a computer simplifies the analytical methods and prevents faults. The data resulting from these investigations are processed so that they can be easily evaluated with respect to many different aspects. The waste water released from seven nuclear power plants is analysed according to this system since 1970. The system is explained and some results are given. (GE)

20422 (AED-Conf-74-157-018) REGULATIONS OF THE RELEASE OF RADIOACTIVE WASTE WATER FROM NUCLEAR POWER PLANTS IN THE FEDERAL REPUBLIC OF GERMANY. Aurand, K. (Bundesgesundheitsamt, Berlin (F. R. Germany). Inst. fuer Wasser), Boden- und Lufthygiene). 1974. 9p. INIS.

From seminar on the monitoring of radioactive effluents; Karlsruhe, F. R. Germany (14 May 1974).

2 figs.; 1 tab.; 3 refs. With abstract.

In the FRG the regulation of the discharge of radioactive effluents from nuclear power plants is based on the principle of keeping the releases as low as possible. Rules for the discharge of radioactive waste.water adopted for licensing procedures of nuclear power installations prescribe the following control measures: collection of all the waste water possibly contaminated redioactively; inhibition of discharge if the activity concentration exceeds 5×10^{-14} Ci/m^3; storage of samples of each discharge; determination of the release activities of the different radionuclides;

annual discharge limits; continuous γ-counting in the discharge line and the outlet of the cooling water; and continuous water sampling from the inlet and outlet of the cooling water. (GE)

20423 (ANL-7962) SODIUM-VOIDING STUDIES IN A PLUTONIUM-FUELED FAST ASSEMBLY (ZPPR-2) OF DEMONSTRATION-REACTOR SIZE, COMPOSITION, AND GEOMETRY. Davey, W. G.; Palmer, R. G.; Collins, P. J. (Argonne National Lab., Ill. (USA)). Mar 1974. Contract W-31-109-Eng-38. 78p. Dep. NTIS $5.45.

A major objective of the Demonstration Reactor Benchmark Program on ZPPR-2 was to study the effect of loss of sodium coolant on the neutronics (static) of large fast reactors. An extensive series of measurements was performed to provide a number of key tests of calculational methods and data. These included the voiding of both large and small zones in different regions of the core. Since one question to be answered was the applicability of sodium-void measurements in plate criticals to rodded power reactors, considerable attention was given to the study of core zones with fuel in the form of rods enclosed in calandria. In addition to the direct measurements of reactivity changes caused by sodium voiding, the effect of voiding on other parameters was studied, including Doppler indices, neutron spectrum, reaction-rate ratios, and small-sample perturbation worths. These provided useful diagnostic data to supplement the main study. A preliminary comparison of experiment and calculations is presented using ENDF/B Version-I data. (auth)

20424 (BNWL-B-357) TRANSPORT AND DEPOSITION OF AIRBORNE FISSION PRODUCTS IN CONTAINMENT SYSTEMS OF WATER COOLED REACTORS FOLLOWING POSTULATED ACCIDENTS. Owzarski, P. C.; Postma, A. K.; Lessor, D. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jun 1974. Contract AT(45-1)-1830. 39p. Dep. NTIS $4.00.

Fission product transport and deposition in containment systems of water cooled reactors are analyzed. The scope of the study involves prediction of fission product behavior from the point of release from the primary coolant system to the entry to the earth's atmosphere. A description of mechanisms which will remove airborne fission products in containment systems, a listing of the calculational methods used to predict removal rates, and a description of a computer code for calculating atmospheric release of airborne substances from a multicompartmented containment system are presented. (auth)

20425 (CEA-CONF-2614) CONTROL OF IODINE TRAPS IN NUCLEAR POWER PLANTS. Sigli, P.; Trehen, L. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1973. 12p. (In French). (CONF-731218-1). Dep. NTIS (US Sales Only) $4.00.

From seminar on the testing of iodine filters; Karlsruhe, F. R. Germany (4 Dec 1973).

A method for the in situ evaluation of the efficiency of iodine traps in nuclear reactors is given. The technique used consists of three steps, injection of ^{127}I, injection of labeled iodine or methyl iodide, and sampling. Each of these steps is described in detail and a graphic outline of the system is shown. (JSR)

20426 (CONF-721237-, pp 307-328) REVIEW OF SAFETY OF FBTR. Bhoje, S. B.; Shankar Singh, R. (Reactor Research Centre, Kalpakkam, India). 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

This review on the safety of FBTR describes the various safety features incorporated into the design of the core, cooling circuits, control systems etc. and indicates the protective devices provided at various stages. The different possible mechanisms of reactivity addition to the reactor and their consequences have been examined. A design base accident has been postulated and analyzed and the containment building provided for the reactor is evaluated from the point of view of public health and safety. (16 references) (auth)

20427 (CONF-721237-, pp 329-336) SIMULATION OF FAST REACTOR ACCIDENTS BY CHEMICAL EXPLOSIVE. Krishnan, L. V.; Attarde, R. B.; Gopinath, D. V. (Bhabha Atomic Research Centre, Bombay). 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

Energy release corresponding to several hundreds of pounds of TNT is likely in fast reactor accidents and an understanding of the effect of such energy release on reactor structures is of vital importance in their design and safety evaluation. The details of a series of tests for the study of structural effects of such energy releases using chemical explosives are presented. The test chambers approximately $1/20$ scale model of FBTR vessel were of mild steel and water was used in place of sodium. The explosive used was PIK-1 and for the size of charges used the energy release time was of the order of 10 μs. (auth)

20428 (GEAP-13923-6) SAFETY ENGINEERING. Sixth Quarterly Report, November 1973-January 1974. (General Electric Co., Sunnyvale, Calif. (USA). Advanced Technology Dept.). Feb 1974. Contract AT(04-3)-893. 14p. AT.

The purpose of the Safety Engineering Task is: (1) to bring into sharp focus both the requirements for specific technical information related to LMFBR safety, and the results of previous studies, wherever performed; (2) to recommend to AEC-RRD a course of action which will provide the information still required. The existing LMFBR national safety development program includes both analytical and experimental programs. The Safety Engineering Task utilized the results of these programs to evaluate their applicability to LMFBR conditions. This goal is obtained by direct use of nationally developed accident-analysis codes and by active participation in the evaluation of safety-related experimental data through both: (1) round-robin analyses of current experimental tests involving ANL and HEDL; (2) independent review and analysis of existing experimental tests. The results of these activities are in the form of correlations of existing data and recommendations on future directions for safety development experimental programs. (auth)

20429 (IRS-W-9) LAY-OUT OF NUCLEAR INSTALLATION AGAINST ACTION FROM OUTSIDE. Derivation of Formulation for the Calculation of the Mechanical Effects on Underground Supply Lines in the Crash of an Airplane for the Calculation of the Minimum Distances of Redundant Supply Lines. Drittler, K.; Gruner, P. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F. R. Germany)). Apr 1974. 50p. (In German). Dep. NTIS (US Sales Only) $5.50.

Formulas for the determination of the minimum required distances between the centers of impact craters in the earth and underground power plant supply lines are presented. The impact craters are assumed to be of cylindrical shape and ending in a half sphere. Distinction is made between supply lines of almost no transversal stiffness and those whose transversal stiffness is extremely large. The effects of local forces as well as those of global forces upon the supply lines are taken into account. Furthermore, these formulas are used to calculate the required minimum distances and depths of redundant supply lines. Impacts resulting from the crash of an entire airplane and those resulting from airplane debris are dealt with separately. (auth)

20430 (IVA-60) SOVIET-SWEDISH SYMPOSIUM ON REACTOR SAFETY PROBLEMS, STUDSVIK, SWEDEN, MARCH 5-7, 1973. Part II. (Aktiebolaget Atomenergi, Studsvik (Sweden); Ingenjoersvetenskapsakademien, Stockholm (Sweden)). Dec 1973. 122p. (CONF-730363-P2; AES-12).

Nine papers are included on reactor safety. A separate abstract was prepared for each paper. (DG)

For abstracts of individual papers see: 20431-20439.

20431 (IVA-60, pp 1-14) SAFETY SYSTEM FOR NUCLEAR POWER STATIONS USING PRESSURIZED WATER REACTORS WITH A CONTROLLED RELEASE OF LOW-ACTIVE COOLANT INTO THE ENVIRONMENT. Bukrinskii, A. M.; Konkiv, A. S.; Maltsev, B. K. Dec 1973.

From Soviet-Swedish symposium on reactor safety problems; Studsvik, Sweden (5 Mar 1973).

A description and the fundamental principles are given for a safety system with controlled partial release of low-activity coolant into the environment in design basis accidents. The main equipment of the system is described and the ranges of its operation are presented. The principal advantages of the proposed system are pointed out and compared to the widely used containment system. (auth)

20432 (IVA-60, pp 15-34) PROCESSES OCCURRING IN A PRESSURIZED WATER REACTOR IN CASE OF PIPE RUPTURE IN THE PRIMARY CIRCUIT AND THEIR INFLUENCE ON THE REACTOR CONSTRUCTION. Steckolnikov, V. V. Dec 1973.

From Soviet-Swedish symposium on reactor safety problems; Studsvik, Sweden (5 Mar 1973).

On the basis of an analysis of the consequences of an accident with ruptures of pipes in the primary circuit of a PWR, general methods for protection of the reactor are given. By using the Lovisa nuclear power station as an example, processes which occur in the reactor at a pipe rupture in the primary circuit are analyzed and methods for protection of the reactor core from overheating and dangerous deformation are analyzed. The following fundamental limiting parameters are considered: the pressure in the primary circuit, the pressure drop in the core and in other reactor components, the quantity of coolant in the reactor and the temperature range of the hottest fuel element. Characteristics of the fundamental relations in the analytical methods are also given. The importance of experimental re-

search is underlined at the choice of optimal means for reactor protection. (auth)

20433 (IVA-60, pp 35-48) SAFETY OF NUCLEAR POWER PLANTS IN VIEW OF THE CONSEQUENCES OF MAJOR ACCIDENTS. Luzanova, L. M.; Pologikh, B. G.; Sidorenko, V. A.; Sevorchevskii, V. D. Dec 1973.

From Soviet-Swedish symposium on reactor safety problems; Studsvik, Sweden (5 Mar 1973).

A calculated evaluation of the danger of a major accident at a nuclear power station, having a PWR, is presented. The values of the necessary attenuation factors are given for the activity of ^{131}I, which is released during the accident, as a function of the size of the containment volume and as a function of the damage of the core. Attention is paid to the choice of optimal relation between size of the leakages of the containment devices (chambers, containers, etc.) and the rate of decay of the activity released during the accident, taking into account economic and other complications associated with the construction of sealed barriers. (auth)

20434 (IVA-60, pp 49-62) EXPERIMENTAL STUDY OF TRANSFER AND DEPOSITION OF FISSION PRODUCTS IN A SIMULATION OF A LEAKAGE IN THE PRIMARY CIRCUIT OF A PWR. Pavlenko, V. I. Dec 1973.

From Soviet-Swedish symposium on reactor safety problems; Studsvik, Sweden (5 Mar 1973).

The results of a study of the transport and deposition of non-gaseous fission products in a simulation of accidental situations related to leakages of the primary circuit in a PWR are presented. The results obtained for the distribution of fission products in the building after a water leak are given. (auth)

20435 (IVA-60, pp 63-76) ENGINEERING PROBABILITY METHODOLOGY FOR NUCLEAR POWER PLANT POTENTIAL HAZARD ASSESSMENT. Klemin, A. I.; Poliakov, E. F. Dec 1973.

From Soviet-Swedish symposium on reactor safety problems; Studsvik, Sweden (5 Mar 1973).

Quantitative methodology for the assessment of potential nuclear hazard to the population is proposed. It is based on a comparison between predicted risk from a nuclear power plant and its permissible value. The engineering approach to the expected risk assessment is presented where risk implies the probability of dangerous influence of fission products released as a result of possible accidents on the individual or the population in the region surrounding the nuclear power plant. The interconnection of the problems of plant reliability, safety, and technical and economical efficiency is considered. (auth)

20436 (IVA-60, pp 77-84) EVALUATION OF DANGEROUS MECHANICAL ACTIONS AT ACCIDENTS IN THE PRIMARY CIRCUIT OF A NUCLEAR POWER STATION. Rzieznikov, Yu. V.; Indurskii, M. S.; Lifshits, E. V. Dec 1973.

From Soviet-Swedish symposium on reactor safety problems; Studsvik, Sweden (5 Mar 1973).

Methods are presented for evaluation of dangerous actions (reaction forces, jets, shock waves and missiles) associated with ruptures in the primary coolant circuit. (auth)

20437 (IVA-60, pp 85-96) RESEARCH ON FLOW OF HOT WATER THROUGH ORIFICES AND TUBES. Keller, V. D.; Maltsev, B. K.; Chlestkin, D. A. Dec 1973.

From Soviet-Swedish symposium on reactor safety problems; Studsvik, Sweden (5 Mar 1973).

Data are reported on the investigation of saturated and subcooled water discharging through orifices and tubes. Inlet pressure (P_0) range was equal to 20-221 bar. Sub-cooling was varied from 0 to 90°C. All test sections had sharp entrance edges, 3.5 mm inner diameter and length-to-diameter rations (l/d) from 0.5 to 30. The measurements were carried out at steady-state conditions. Data on mass flow rate (G) as a function of (l/d), inlet pressure, and temperature were obtained. The influence of (l/d) on flow rate is significant for $l/d < 12$ and in particular for $P_0 = 60-160$ bar. For $P_0 = 160$ bar this influence decreases with increasing pressure. Near the critical point (221 bar) the (G) value is almost independent of (l/d). The nature of flow rate versus inlet pressure demonstrates the boiling of saturated water for $P_0 > 70$ bar even within the short channels ($l/d = 0.5 + 8$). This conclusion corresponds to the existing data on metastability decrease with pressure increase. (auth)

20438 (IVA-60, pp 97-112) SOME SAFETY ASPECTS ON SODIUM COOLED FAST REACTORS. Bagdasarov, Yu. E.; Kuznetsov, I. A. Dec 1973.

From Soviet-Swedish symposium on reactor safety problems; Studsvik, Sweden (5 Mar 1973).

Fast reactor aspects connected with reactor dynamics at perturbations of all external channels (reactivity, coolant flow and coolant inlet temperature) are considered. Parameters are given for the dynamic properties of reactor type BN-350 in the automatic regulation and self regulation regimes. The requirements on the emergency situation signal systems, automatic regulation and component block systems are formulated. (auth)

20439 (IVA-60, pp 113-120) EXPERIMENTAL STUDIES OF RADIATION SAFETY QUESTIONS OF THE REACTOR BOR-60. Gryazev, V. M.; Kobzar, I. G.; Konyashov, V. V.; Polyakov, V. I.; Checketkin, Yu. V. Dec 1973.

From Soviet-Swedish symposium on reactor safety problems; Studsvik, Sweden (5 Mar 1973).

An analysis of the radioactive isotope composition of the sodium coolant and gas in the gas plenum of the reactor and pumps, a study of the variation of the activity of the radioactive isotopes as a function of time, and calculated permanent leakages of radioactive noble gases from the coolant and gas plena are given. The radiation conditions are studied, the level of the gamma radiation in the service chambers is given and the release of gases from the reactor is analyzed. Results from a study of the consequences of releasing high temperature sodium into the service chambers with natural ventilation are given. The use of different means for the suppression of sodium fires is considered. It is shown that the quantity of released combustion products into the air of the service chambers depends on the choice of material for the thermal insulation of the pipes. (auth)

20440 (PB-228864) NUCLEAR INSURANCE: AN ESTIMATE OF THE COST OF THE NUCLEAR HAZARD. Schleicher, R. W. (Cornell Univ., Ithaca, N. Y. (USA)). Oct 1971. 21p. Dep. NTIS $4.25.

An investigation of the cost of the nuclear hazard as estimated by the nuclear insurance industry and the United States Government is presented. The investigation is divided into two parts: (1) The description of the nuclear insurance program in the United States including private and governmental coverage, premium rates and indemnification fees. (2) A calculation of the expected cost of the nuclear hazard from information about the premium rate structure and indemnification fees. (auth)

20441 REACTOR SAFETY: REAL PROBABILITIES. Rasmussen, N. (Massachusetts Inst. of Tech., Cambridge). Combustion; 45: No. 12, 8-13(Jun 1974).

From second international workshop; Lucerne, Switzerland (5 May 1974).

Reactor safety is discussed from the standpoint of the real probabilities and frequencies of nuclear incidents which might have any significant effect on the public. Reliability of reactor components and effectiveness of emergency core cooling systems are considered, and comparisions are made between the health effects of nuclear power and other forms of power generation. (auth)

20442 NUCLEAR ENERGY ENVIRONMENTAL PROBLEM AND AGRs. Yamada, M.; Morimoto, T. (Fuji Electric Co., Ltd., Tokyo). FAPIG (Tokyo); No. 70, 81-87(Aug 1973). (In Japanese).

Among the various types of nuclear reactors, AGRs produce the least environmental problem. This is due to the high overall thermal efficiency and the clean coolant. The environmental consequences of nuclear energy depend largely on the design features of nuclear reactors. By increasing the thermal efficiency of reactor plants, the relative amount of heat uselessly released and radioactivity can be lowered. The retention of the radioactivity accruing in the operation of nuclear reactors is improved more at the stage of fuel cladding than by reducing the amount of radioactive wastes. The following are described: environmental problems of nuclear energy; features of the AGRs including thermal efficiency, fuel design, etc.; and radioactive wastes from the AGRs, including gaseous, liquid and solid wastes. (JA)

20443 NUCLEAR POWER STATIONS IN EUROPE. Nuclear Plants and the Environment. Salvetti, C. (Comitato Nazionale per l'Energie Nucleare, Rome). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 105, 6-19(Jan 1974). (In French).

From fifth FORATOM congress on nuclear power plants in Europe; Florence, Italy (15 Oct 1973).

Environmental problems presented by nuclear power plants (radiation dangers, thermal effects, effects on the landscape, and effects on the tourist industry) are examined. The ways in which these problems have influenced the technological solutions are discussed together with the authorization procedures for the installation of nuclear plants. An attempt is made to analyze the attitude of the public towards the construction of nuclear plants (controversy, opposition, and information). (FR)

20444 SAFETY TESTS OF THE MAIN STEAM SEPARATION VALVE AND THE NON-RETURN VALVE FOR PROTOTYPE ATR "FUGEN". Tokumitsu, M. (Power Reactor and Nuclear

Fuel Development Corp., Oarai, Japan). Doryokuro Giho; No. 8, 43-54(Aug 1973). (In Japanese).

In the prototype JATR, a steam separation valve and a non-return valve are employed. The former is used to close the main steam pipe from the reactor core in case of external piping rupture and fuel failure, and the latter is used to stop cooling-water escape from the reactor in case of pipe rupture and also to secure injection of emergency cooling-water into core. Performance tests, especially concerning safety operation, made on these two valves are described. In the steam separation valve, the axis is inclined to the piping to reduce the resistance to steam flow. The non-return valve is of the swing type ordinarily used. Shock pressure and other problems with both valves are discussed. (JA)

20445 SAFETY ANALYSIS OF A STEAM GENERATOR EMPLOYED FOR "MONJU". Sakano, K.; Takitani, K.; Shindo, Y. (Kawasaki Heavy Industries Ltd., Kobe, Japan). FAPIG (Tokyo); No. 70, 68-79(Aug 1973). (In Japanese).

Improved reliability and safety of steam generators is important for sodium cooled fast breeder reactors. To achieve these improvements, the stability of fluid flow in the regions of water and steam must be established as well as safety in sodium-water reactions. To evaluate these problems, analytical codes were developed. The stability of fluid flow and the sodium-water reactions were analyzed by using these codes. With regard to the flow stability in case of load factor of 30 to 100%, the following results were acquired: The escaping instability of flow and uneven flow distribution of water did not occur. In order to avoid density wave oscillation type instability, an orifice with inner diameter smaller than 2.7 mm must be mounted on each inlet of heating tubes of evaporators. With regard to the safety at the time of break-down of heating tubes, the following results were obtained: The maximum pressure in evaporators at the time of the break-down of tubes was evaluated to be 145 atm. This pressure is lower than feedwater pressure (147 atm). The peak pressure in superheaters also did not exceed 140 atm. The pressure spike in reheaters exceeded the steam pressure of 33 atm and reached 54 atm. As a result, it was found that the steam generators must be designed so that they are not ruptured when the pressure on the sodium side of steam evaporators, superheaters and reheaters reached 147atm, 140atm and 54atm, respectively. (JA)

20446 NUCLEAR ENERGY, SAFETY, AND ENVIRONMENT. Eklund, S. (International Atomic Energy Agency, Vienna). Rev. Fr. Energ.; 25: No. 259, 302-309(Jan 1974). (In French).

Enormous supplementary quantities of energy are required for maintaining the quality of life both from the demographic point of view and that of the increasing quantities of energy required to produce vital raw materials. Only fission energy can currently be envisaged as being capable of fulfilling these needs (from both the technological and economics points of view). Emphasis is placed on the reliability of currently used reactors and on the measures taken to protect the environment from any detrimental effects due to radioactive wastes. (FR)

20447 QUALITY ASSURANCE IN THE CONSTRUCTION OF NUCLEAR POWER PLANTS. Fujimoto, H.; Manabe, Y. (Hitachi Ltd., Ibaraki, Japan). Haikan Gijutsu; 15: No. 13, 80-89(Sep 1973). (In Japanese).

The growth of nuclear power generation has been marked in recent years, and a high degree of safety is required of plant facilities. The procedures of quality assurance and quality control for the construction of nuclear power plants such as reactor pressure vessels and purchased equipment are described on the basis of ASME Code Section III as follows: (1) personnel organization for quality assurance concerning responsibility, etc., (2) quality assurance and document control in design, (3) personal ability of designers, (4) proper document control, (5) quality assurance for materials and parts purchased, (6) quality control in construction and installation (in which the problems of quality occur most frequently), (7) qualifications of inspecting personnel, (8) calibration of testing and inspection instruments, (9) control of unacceptable products, and (10) supervision on quality-control aspects. (JA)

20448 APPLICATIONS OF WASTE PROCESSING SYSTEMS FOR PRESSURIZED WATER REACTORS. Garber, I.; Kearton, W. (Westinghouse Electric Corp., Pittsburgh). IEEE (Inst. Elec. Electron. Eng.), Trans. Power App. Syst.; PAS-93: No. 1, 149-157(1974).

From IEEE PES summer meeting and EHV/UHV conference; Vancouver, B. C. (15 Jul 1973).

An introduction to the application of Waste Processing Systems in the Westinghouse Pressurized Water Reactor Plants is provided. The systems employ the techniques of waste product concentration, long term storage, recycling, and radiation monitoring in order to implement the basic philosophy governing radioactive releases established by national and international guidelines. In the United States, the limits of radioactive release are established by the Code of Federal Regulations of the Atomic Energy Commission. (auth)

20449 DISTORTION OF THE TEMPERATURE FIELD IN THE CORE OF A FAST REACTOR DUE TO FAILURE IN HEAT REMOVAL IN ONE OR MORE SUBASSEMBLIES. Buksha, Yu. K.; Bagdasarov, Yu. E.; Kuznetsov, I. A. At. Energ. (USSR); 35: No. 5, 311-314(Nov 1973). (In Russian).

An emergency situation in the core of a fast reactor, resulting from a decrease in sodium flow through one or more subassemblies, is considered. Temperature fields in the reactor are calculated. (auth)

20450 FAST REACTOR SAFETY. Farmer, F. R. (United Kingdom Atomic Energy Authority, Culcheth, Eng.). Ann. Nucl. Sci. Eng.; 1: No. 4, 255-264(Apr 1974).

The difficulty of defining the meaning of "safe" in discussing reactor safety is considered in relation to potentially hazardous situations, both natural and man-made, which occur in everyday life. The author then aims at producing qualitative evidence to show that the risk from fast reactors is small. The way in which the safety of fast reactors is being established is illustrated first by selected examples indicating the nature of safety studies for both the predetermined and the more general type of reactor accident and then by consideration of the "way-out" or "near-incredible" accident such as the situation which results in Na boiling and fuel meltdown with eventual dispersion of the core. Work is being carried out in several countries on processes associated with core dispersion. As more information becomes available it is expected, on the basis currently adopted for the design of primary containment, that a very wide safety margin will be found to exist between the likely range of accident consequences and the capability of the design to meet them. (UK)

20451 NUCLEAR POWER STATIONS-INSURANCE AND PREVENTION OF DAMAGE. Hossner, R. (Handelsblatt G.m.b.H.; Duesseldorf). Kernkraftwerke-Versicherung und Schadensverhuetung; 19: No. 5, 258-259(May 1974). (In German).

Nuclear power plant insurance and the prevention of damage were one of the main topics of the 7th technical colloquium organized by the Allianz Insurance Company. Prevention of possible serious malfunctions could be improved considerably by constructional measures and advanced testing methods. Another step forward in this direction is the experience gained in the performance of complicated repair work. (GE)

20452 CRITICAL REVIEW AND COMPARISON OF THE NUCLEAR POWER PLANT SITING POLICIES IN THE UNITED KINGDOM AND THE UNITED STATES OF AMERICA. Shaw, J. (Queen Mary Coll., London); Palabrica, R. J. Ann. Nucl. Sci. Eng.; 1: No. 4, 241-254(Apr 1974).

The methods adopted for evaluating the suitability of sites for the construction of nuclear power plants in the U. K. and the U. S. A. have been described in detail. An attempt has been made to derive common grounds by which the two siting policies may be compared with each other. With this aim in mind, the risks to the individual and to the total population around the site have been assessed assuming that the same accident criteria apply for the two different siting policies. The siting policies have also been contrasted with regard to their adequacy in safe guarding the public against accidental events. In the case of the U. K. policy a revised assessment has been carried out using more up to date data and refined calculations. (auth)

20453 PUBLIC ACCEPTANCE OF NUCLEAR POWER IN CANADA. Davies, J. E. O. (Ontario Cancer Inst., Toronto). Nucl. Eng. Int.; 19: No. 217, 513-514(Jun 1974).

The attitude of the Canadians towards the domestic nuclear power program is described. Until recently the program has escaped criticism and debate about nuclear safety. This situation has now changed and there is a trend towards greater public security and involvement. The issues involved in the change in public response are discussed. (UK)

20454 HOW SAFE ARE FAST BREEDERS? A Discussion in the USA. Nachr. Chem. Tech.; 22: No. 8, 155(Apr 1974). (In German).

3 refs.

The nuclear controversy in the United States, especially on the potential hazards from plutonium-239 and americium-241, originating from the planned fast breeder reactors is reviewed. (GE)

20455 CLEAR AND PRESENT DANGER: A PUBLIC REPORT ON NUCLEAR POWER PLANTS. Canoga Park, CA; Environmental Education Group ([nd]). 48p.

Information is provided on potential dangers from nuclear power plants, including radioactive waste disposal, leakage accidents, transportation of radioactive materials, design flaws, sabotage, and nuclear highjacking. A list of nuclear facilities in the U. S. is given, along with comments by scientists, environmentalists, and political leaders on energy problems and dangers involved in nuclear reactor proliferation. (Pollut. Abstr)

Reactor Theory and Calculation

Refer also to abstracts 19996, 20397, 20398, and 20405.

20456 (ANS-RPD-4, pp 12-54) STATUS OF REACTOR PHYSICS TECHNOLOGY RELATED TO Pu-RECYCLE FUEL LICENSING. Schmid, L. C.; Carter, N. E.; Jenquin, U. P.; Leonard, B. R. Jr.; Wolkenhauer, W. C. (Battelle Pacific Northwest Labs., Richland, WA). [nd].

From proceedings on physics of plutonium recycle; Miami, Florida, USA (Oct 1971).

In special session of invited papers on physics of plutonium recycle.

Various aspects of reactor physics technology is briefly reviewed with respect to technology required for plutonium recycle core licensing. Some of the considerations that need to be given to the neutronic design of plutonium light water cores are pointed out. The results of studies to date show that the basic technology is generally adequate to evaluate the effects of introduction of significant amounts of plutonium in the uranium cores. The basic cross section data are comparable to those for the uranium cores. The expected uncertainties because of cross sections are probably less than can be expected from the uncertainties introduced by the calculational methods and the models used in representing the reactor core. In particular, special consideration needs to be given to the thermalization calculation and its accuracy. Whether the major uncertainty lies in the H_2O scattering kernel or the transport theory used in the thermalization calculation has not been established. While one can be confident of the accuracies involved in calculating the characteristics of fuel loaded in critical assemblies, one should not expect a priori to be able to understand the accuracies involved in calculating the same parameters in a commercial power reactor. The complex geometry of those reactors introduces additional uncertainties because of the various ways that one can identify models to be used to mock up the commercial reactor environment. In addition, there are unanswered questions concerning the ability of the calculational methods to accurately calculate radioisotope inventories and reactivity loss rate for a plutonium core. Additional attention needs to be given to determining the accuracy involved in calculating a reactivity loss rate and to normalization of methods using data developed during the power reactor operation. (auth)

20457 (ANS-RPD-4, pp 92-143) SIGNIFICANT ITEMS ON THE FEATURES OF Pu-RECYCLE FROM PHYSICAL AND TECHNOLOGICAL STANDPOINTS. Orestano, F. V. (CNEN, Rome); Pistella, F.; Testa, G. [nd].

From proceedings on physics of plutonium recycle; Miami, Florida, USA (Oct 1971).

In special session of invited papers on physics of plutonium recycle.

Measurements were made at the RITMO reactor to obtain data, which were used to test plutonium recycle calculational results, on (1) heterogeneous effects on reactivity and power distributions, (2) the effects on reaction rates due to spectral pecularities of plutonium, and (3) the effects on reactivity and power distribution due to burnable poison pins (Gd_2O_3/UO_2). (auth)

20458 (CONF-721237-, pp 417-423) INTEGRAL TRANSFORM METHOD FOR MULTIDIMENSIONAL NEUTRON PROBLEMS WITH LINEARLY ANISOTROPIC SCATTERING. Sahni, D. C. (Bhabha Atomic Research Centre, Bombay). 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

20459 (CONF-721237-, pp 425-450) METHODS FOR THE CALCULATION OF HETEROGENEITY EFFECTS IN CRITICAL ASSEMBLIES. Zhukov, A. V.; Kurobeinikov, V. V.; Nikolaev, M. N.; Orlov, M. Yu.; Usikov, D. A. (Physics and Power Inst., Obninsk, USSR). 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

Various methods are given for the calculation of the effect of heterogeneous arrangement of fuel and other materials of the core of the critical assembly on its integral characteristics. The statement is illustrated by the examples of the calculation of heterogeneity effect on the results of averaging the constants for the calculation of the critical assemblies, on the calculated neutron spectrum and the energy dependence of the neutron importance. (32 references) (auth)

20460 (CONF-721237-, pp 451-456) TIME DEPENDANT STUDIES IN REACTOR THEORY. Chandra, S. (Bhabha Atomic Research Centre, Bombay). 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

Some of the analytical and numerical approaches developed or adopted to study the time behavior of the reactor systems are reviewed. These studies are, generally, intended to find out the reactor response in power, fuel temperature, coolant temperature etc. under hypothetical perturbations with the object to determine the safe operating conditions of the reactor. In the present analysis point reactor kinetic equations are assumed to be valid. The dependance of reactivity function on temperature is neglected in analytical methods but is included in numerical methods. (7 references) (auth)

20461 (CONF-721237-, pp 485-494) USE OF CROSS-SECTION SELF-SHIELDING FACTORS IN FAST REACTOR CALCULATIONS. Gupta, H. P.; Kapil, S. K. (Bhabha Atomic Research Centre, Bombay). 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

Three interpolation schemes for the self-shielding factors as a function of background cross-section and temperature, are chosen and the sensitivity of various reactor parameters to the choice of the interpolation scheme is investigated. (3 references) (auth)

20462 (CONF-721237-, pp 495-513) IMPROVING THE NUCLEAR DATA FOR FAST REACTORS ON THE BASIS OF THE ANALYSIS OF INTEGRAL EXPERIMENTS. Antonova, L. V.; Bazazyants, N. O.; Nikolaev, M. N.; Orlov, M. Yu. (Physics and Power Inst., Obninsk, USSR). 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

The work pertaining to the use of the results of the measurements of the integral characteristics in critical assemblies (ratios of the cross-section, reactivity ratios, keff) has been surveyed for improving the systems of constants that are used for the calculation of fast reactor. The general method is given for introducing the corrections in the constants and its modifications which have been used by many authors. The possibility is examined of introducing the corrections with respect to the results of the integral experiments in the cross-sections which are given in parametric form. Examples of the results are given for using the described methods for obtaining the corrections. (23 references) (auth)

20463 (CONF-721237-, pp 515-521) RESONANCE GROUP CROSS SECTIONS FOR MULTIGROUP CODES. Huria, H. C.; Paranjape, S. D. (Bhabha Atomic Research Centre, Bombay). 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

The methods used to calculate the resonance group cross-sections for ^{238}U, ^{235}U and ^{239}Pu are described. The slowing down equation is solved in an infinite homogeneous mixture of the heavy absorber and a moderator. Hydrogen has been used in the present calculations as the moderator. By varying the composition of the mixture various representative spectra can be generated. The slowing down equation is solved by the multigroup method using a very large number of fine groups. The group widths are not fixed, and are, in fact, adapted to the slopes of the resonance lines. (auth)

20464 (FEI-384) ANALYSIS OF INTEGRAL IMPULSE METHODS FOR MEASURING REACTIVITY. Stumbur, E. A.; Shokod'ko, A. G.; Zhuravlev, V. I.; Matveenko, I. P.; Milyutina, Z. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 33p. (In Russian). Dep. NTIS (US Sales Only) $4.75.

The bases of the theory of the integral pulse method for the measurement of the reactivity were examined. The conditions for obtaining reliable values of the reactivity by use of the combined integral method and its modification were shown. The results of the experimental verification of the integral method were reported for the variants of the slow neutron reactor. Algorithms and programs for the numerical multigroup calculation (in the $2P_0$ approximation) of the neutron distribution and the basic functionals determining the results of the integral pulse method were developed. Comparison of the experimental and calculation results yielded practical recommendations on methods for the most reliable determination of the reactivity from integral pulse experiments. (tr-auth)

20465 (FEI-413) INTER-CANAL INTERACTION OF COOLANT IN THE LATTICES OF CYLINDRICAL RODS. Zhukov, A. V.; Muzhanov, A. B.; Sorokin, A. P.; Titov, P. A.; Ushakov, P. A. (Gosudarstvenny Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1973. 57p. (In Russian). Dep. NTIS (US Sales Only) $6.00.

Data on the interchannel exchange of coolant in lattices with cylindrical rods were reviewed. The data available in this area were systematized. A system of energy equations for triangular lattices with hexahedral boiler courses was solved. For cases of "fin to fin" spacing of the rods the mixing coefficients were calculated for assemblies with s/d = 1.15. Some considerations on the experimental study of the coefficients of interchannel exchange were discussed. (tr-auth)

20466 (TUBIK-29) MONTE CARLO CALCULATION OF THE GEOMETRIC PERTURBATION IN NUCLEAR REACTORS USING ADJOINT RELATIONS. Lindauer, E. (Technische Univ. Berlin (F. R. Germany). Inst. fuer Kerntechnik). Dec 1973. 130p. (In German). Dep. NTIS (US Sales Only) $9.50.

Thesis.

A method is presented for the Monte Carlo calculation of differences of integral events caused by geometrical perturbations in nuclear reactors. A source distribution on a surface encompassing the region of perturbation results from an adjoint calculation and is used to construct a difference flux. The change of the interesting event due to the changed eigenfunction is taken into consideration approximately. A one dimensional test problem is calculated and its results are compared with those obtained from a discrete ordinates code. The comparison permits examination of the quality of the approximation used for the change of the source distribution. The reactivity change due to a moving control element of the critical ITR experiment is calculated and compared with experimental data. (auth)

20467 OPTIMAL EQUALIZING OF THE HEAT RELEASE OVER THE REACTOR VOLUME. Zaritskaya, T. S.; Rudik, A. P. Sov. At. Energy (Engl. Transl.); 35: No. 3, 843-846(Sep 1973).

Translated from At. Energy (USSR); 35: No. 3, 200-202(Sep 1973).

A one dimensional reactor without a reflector is used as a model to obtain the fuel distribution which minimizes the standard deviation of the heat release over the reactor volume. (DG)

20468 METHOD OF CARRYING OUT AND EVALUATING ROD-DROP EXPERIMENTS. Liewers, P.; Scholz, J. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 17: No. 5, 136-139(1974). (In German).

For the analysis of rod-drop experiments a method has been developed which permits a determination of rod efficiency by means of fitting the measured values to a model for the correction of the prompt jump influenced by space-dependent effects. The measurements are made by means of an analog reactivity meter. The procedure was used in rod-drop experiments at the RRR research reactor and at the Rheinsberg nuclear power plant reactor. The results are given and discussed. (auth)

20469 EFFECTIVE ADMIXTURE CROSS SECTION IN PLATE LATTICE HETEROGENEOUS SYSTEMS. Kikuchi, Y. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 11: No. 5, 226-228(May 1974).

Reactor Components and Accessories

Refer also to abstracts 18387, 18388, 19252, and 20421.

20470 (AED-Conf-74-044-008) DESIGN AND APPLICATION OF PACKLESS VALVES IN NUCLEAR ENGINEERING. Visalli, R. G. 1974. 14p. (In German). INIS.

From exhibition and experts' meeting 'Nuclear Technology'; Frankfurt am Main, F. R. Germany (18 Mar 1974).

4 figs. With abstract.

The number of packless values used in nuclear engineering increases proportional to the number of operating hours of nuclear power plants all over the world. As engineers everywhere are well aware of the problems associated with leak formation at the valve shaft and the corresponding repair and maintenance work, there is an ever increasing demand for valves avoiding these difficulties. Aspects of the design of packless metal diaphragm values to be used in nuclear installations, the analysis and design features of metal diaphragms as well as the use of valves with packing for various purposes in nuclear engineering are described. (GE)

20471 (JUL-1024-RX) COMPUTER-AIDED THERMAL DESIGN OF MATERIALS AND FUEL IRRADIATION RIGS. Butzek, D. A.; Stelzer, F. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralinstitut fuer Reaktorexperimente). Nov 1973. 39p. (In German). INIS.

Thermodynamic calculations for experimental rigs for studying the behaviour of fuels of structural materials under irradiation is one of the standard tasks in rig design. These design calculations can be performed with the aid of a computer program capable of being adjusted to the conditions of a particular experiment. The program described can also be modified so as to be applicable to various types of rigs. It has been used to perform the design calculations for the experimental rigs installed in the Juelich reactors and for those used in the reactor BR-2 in Mol, Belgium. (GE)

20472 (RDT-C-17-9-T(6-74)) FOIL-SHIELDED INSTRUMENTATION CABLE. (USAEC Division of Reactor Research and Development, Washington, D. C.). Jun 1974. 20p. RSO.

Requirements for armored and unarmored foil-shielded instrumentation cable for use in nuclear reactor facilities outside the reactor vessel are presented. The cable is intended for use in the transmission of instrumentation and control signals in an environment where the signal-to-noise ratio is degraded by the coupling of electric fields associated with electromagnetic noise sources. (auth)

20473 (RDT-F-9-5-T(3-1974)) GUIDELINES AND PROCEDURES FOR DESIGN OF NUCLEAR SYSTEM COMPONENTS AT ELEVATED TEMPERATURES. (USAEC Division of Reactor Research and Development, Washington, D. C.). Mar 1974. 273p.

This standard provides guidelines and procedures which may be used by the manufacturer in satisfying the requirements given in RDT F 9-4. Guidance is given for planning and control of design analysis; a sequence for calculations is recommended. Methods of analysis including environmental effects are given. A format is provided for documentation of design analyses. (DLC)

20474 RIDDLE OF BONDED AND UNBONDED TENDONS IN PRESTRESSED CONCRETE REACTOR VESSELS. Bangash, Y. (Thames Polytechnic, London). Concrete; 8: No. 6, 46-48(Jun 1974).

An account is presented of the advantages and disadvantages of bonded and unbonded tendons in prestressed concrete reactor vessels. A theoretical analysis based on a two-dimensional finite element has been developed for computing bond stresses between the type and size of a tendon and the surrounding concrete. Finally, on the basis of bond stress investigation, various tendons and their sizes are recommended to be classified under bonded and unbonded schemes when they are used in prestressed concrete reactor vessels. (UK)

20475 EXPERIMENTAL INVESTIGATION OF THE INFLUENCE OF STRAIGHT THROUGH CYLINDRICAL CHANNELS ON THE PROPERTIES OF IRON-GRAPHITE SHIELDING. Holman, M. (Zavod Vystavba Jaderanych Elektraren, Plzen, Czech.). Jad. Energ.; 20: No. 4, 109-113(Apr 1974). (In Czech).

The effects of cylindrical channels on the fast neutron shielding properties of iron-graphite laminations were determined experimentally. The method of measuring the effect of channel dimensions on shielding properties and the results obtained are described. The results are presented in a form which permits a direct determination of the fast neutron flux density along the channel centerline as a function of channel diameter and isotropic neutron source area. (auth)

20476 PROCESS AND DEVICE FOR THE USE OF HIGH TEMPERATURE THERMAL ENERGY. Sourlau, D. (to Gaz de France). French Patent 2,167,352. 13 Jan 1972. 9p. (In French).

In order to achieve a high thermodynamic efficiency, thermal power plants are required to function at high temperatures. The installations thus require complicated technologies. In the process described, at least some of the heat produced in the thermal cycle is used to decompose water. This decomposition involves a complex cycle using potassium and lead; a simple technology, however, is used to dissociate the water into its two components: oxygen and hydrogen. The process is principally intended for nuclear power plants. (FR)

20477 FACTORS INFLUENCING RELIABILITY OF LARGE GENERATORS FOR NUCLEAR POWER PLANTS. Joyce, J. S. (Allis-Chalmers Power Systems, Inc., West Allis, WI); Abolins, A.; Lambrecht, D. IEEE (Inst. Elec. Electron. Eng.), Trans. Power App. Syst.; PAS-93: No. 1, 210-219(1974).

From IEEE PES summer meeting and EHV/UHV conference; Vancouver, B. C. (15 Jul 1973).

The saturated steam conditions of light-water reactors favor the use of 1500 or 1800 r/min turbines with four-pole generators which are already being built in ratings up to and even exceeding 1500 MVA. Recent developments in gas-cooled reactors give rise to an additional need for 3600 r/min turbines with large two-pole generators. Historically more dependable than two-pole machines, the four-pole generators also possess characteristics that permit higher ratings with components and materials already available to designers today. The characteristics of two and four-pole generators are compared, and the salient features of the largest four-pole generators now under construction are discussed with special reference to their contribution toward service reliability. (auth)

20478 ULTRASONIC TESTING OF REACTOR COMPONENTS FOR UNDERCLADDING CRACKS. Kolb, K.; Woelfel, M. Materialpruefung; 16: No. 3, 74-75(Mar 1974). (In German).

3 figs.; 2 refs.

In ultrasonic experiments for the detection of undercladding cracks, the detection probability could be increased compared with methods using a rigid block test cap. An adjustable test cap was developed, the technical properties of which and the results obtained are described. (GE)

20479 RESULTS OF MEASUREMENTS OF PLUME DROPLET CONTENT OF A 130-METER NATURAL-DRAFT COOLING TOWER. Bung, W. (Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (F. R. Germany)). Tech. Ueberw.; 15: No. 3, 83-87(Mar 1974). (In German).

4 figs.; 5 tabs.; 4 refs.

The drift eliminator will remove predominantly the larger droplets resulting from spattering. On the average, these droplets are bigger in size than those resulting from condensation. The environmental impact due to droplet showers from cooling tower plumes is essentially determined by the amount of droplets above a certain size contained in the plumes. This environmental effect can be reduced to negligible values for most of the meteorological conditions by installing an efficient drift eliminator. The droplet content of plumes from cooling towers equipped with a drift eliminator is mainly due to condensation. The size of these droplets is strongly influenced by meteorological conditions. (GE)

20480 DEVELOPMENT OF TURBINE GENERATORS FOR NUCLEAR POWER. Parsons, N. C. (Parsons (C. A.) and Co. Ltd., Newcastle Upon Tyne (UK)). Arch. Energiewirtsch.; 28: No. 7, 343-350(Apr 1974). (In German).

3 figs.; 2 tabs.; 1 ref.

The development of turbine generators for various types of nuclear power plants by several manufacturers is described and compared. As a result of this comparison, a review is given of the turbine generators currently installed in nuclear power plants, along with their corresponding design and output data and a summary of operating experience up to date. (GE)

20481 N-16 NUCLEAR REACTOR COOLANT FLOW RATE MEASURING SYSTEM. Gopal, R.; Weiss, H. H. (to Westinghouse Electric Corp.). US Patent 3,818,231. 18 Jun 1974. Filed Date 20 Jul 1971. 6p.

A method is disclosed for measuring the primary coolant flow rate in the coolant loops of a nuclear reactor which utilizes the statistical variation of the N-16 activity in the coolant water. The flow rate is calculated based upon knowing the distance between two N-16 detectors positioned along the reactor coolant loops and determining the time which elapses for an activity pattern to travel from one detector to a second detector positioned downstream. (Official Gazette)

20482 ^{16}N REACTOR POWER MEASURING SYSTEM. Weiss, H. H. (to Westinghouse Electric Corp.). US Patent 3,822,184. 2 Jul 1974. Filed Date 30 Dec 1970. 6p

An ^{16}N reactor power measuring system is disclosed for measuring the thermal power of a nuclear reactor. The system includes a build-up simulator in a feedback loop to compensate for the incomplete decay of the ^{16}N in the coolant loop before the coolant is returned to the reactor. (Official Gazette)

20483 POWER PLANT AND METHOD FOR GENERATING PEAK POWER THEREIN. Gilli, P. V. (to Wagner-Biro A. G.). US Patent 3,818,697. 25 Jun 1974. Priority Date 6 Nov 1970, Austria. 18p.

A power plant, such as a nuclear power plant, and a method for generating peak power therein are described. The power plant has a thermal accumulator installation composed of main and superheat accumulators so that after the latter are charged steam for peak-power purposes may be derived therefrom in order to operate a turbine through steam generators and superheaters connected to the accumulators through conduits which operate at different pressure-and-temperature levels. The contents of at least some of the accumulators are circulated by a circulating means a plurality of times through the latter accumulators with the circulated contents of any one accumulator being successively directed to flow paths of progressively lower pressure-and-temperature levels during successive circulations of its contents therethrough. (Official Gazette)

20484 APPARATUS FOR MEASURING THE LOCAL NEUTRON DENSITY DISTRIBUTION IN THE INTERIOR OF A NUCLEAR REACTOR. Fracke, A.; Wachtler, H. (to Siemens Aktiengesellscheft). US Patent 3,819,946. 25 Jun 1974. Priority Date 5 Aug 1971, F. R. Germany. 4p.

A system is described which measures the local neutron density distribution in the fission zone within a nuclear reactor. The measuring system includes a guide tube mounted in and extending through the reactor wall and the fission zone. A probe configured as a helical spring is mounted for motion within the interior of the guide tube and is driven by compressed air between activation and measurement positions located internally and externally of the reactor vessel, respectively. A measuring unit is connected with the guide tube for measuring the level of radioactivity of the probe when it is in its measurement position. (Official Gazette)

20485 SUPPORTING AND SEALING DEVICE APPLICABLE TO ROTARY SEAL PLUGS IN NUCLEAR REACTOR SHIELD SLABS. Jacqueline, R. (to Commissariat a l'Energie Atomique). US Patent 3,819,479. 25 Jun 1974. Priority Date 6 Oct 1971, France. 6p.

The top face of the reactor shield slab is provided in the portion adjacent to the seal plug opening with a flat bearing rim which supports the annular flange of the plug and is slightly raised with respect to the remainder of the slab. Provision is made between the plug flange and the top slab face for sealing means consisting of flexible O-ring seals, sliding means consisting of friction slideways, lifting means consisting of inflatable seals, ducts being provided in the slab for injecting a barrier of neutral gas under pressure. (Official Gazette)

Reactor Fuels

Refer also to abstracts 18399, 18400, 19111–19113, 19127, 19156, and 19251.

20486 STRUCTURAL CHARACTERISTICS OF RECTIFIED UO_2 PELLETS FOR NUCLEAR REACTORS. de Souza Santos, T. D.; de Freitas, C. T.; Haydt, H. M.; Gentile, E. F.; Filho, F. A. (Instituto de Energia Atomica, Sao Paulo, Brazil). Rev. Met. (Madrid); 29: No. 182, 45-51(Jan 1973). (In Portuguese).

The manufacturing of high density sintered fuel pellets from UO_2 powder is described. The discussion covers (1) characteristics of UO_2 powder, (2) physical and chemical properties of different ceramic powders, (3) microstructure of the sintered pellets, and (4) surface preparation of the pellets. (auth)

20487 NUCLEAR FUEL FABRICATION FOR COMMERCIAL ELECTRIC POWER GENERATION. Kushner, M. P. (Westinghouse Nuclear Fuel Division, Columbia, SC). IEEE (Inst. Elec. Electron. Eng.), Trans. Power App. Syst.; PAS-93: No. 1, 244-247(1974).

From IEEE PES winter meeting; New York (28 Jan 1973).

The manufacturing of UO_2 fuel for use in commercial power reactors is described. The manufacturing and processing steps associated with the conversion of uranium hexafluoride gas into UO_2, the compacting of UO_2 pellets, and the assembling of fuel rods and fuel assemblies are explained in detail. (auth)

20488 NUCLEAR REACTOR FUEL ELEMENT. Malang, S. (to Gesellschaft Kernforschung mbH). US Patent 3,813,287. 28 May 1974. Priority Date 17 Nov 1970, F. R. Germany. 4p.

In a nuclear reactor fuel element containing a body defining one region in communication with the element fuel zone and another region containing a vaporizable fluid, the body is in the form of a cartridge separately inserted into the fuel element casing. (Official Gazette)

20489 NUCLEAR REACTOR FUEL ASSEMBLY SPACER GRID. Leaver, B.; Mercer, W. (to United Kingdom Atomic Energy Authority). US Patent 3,813,288. 28 May 1974. Priority Date 7 Jul 1971, United Kingdom of Great Britain and Northern Ireland. 4p.

A spacer grid in a fuel element assembly including a plurality of elongate fuel pins supported in a bundle with their longitudinal axes parallel comprises intersecting strip members which extend in at least two directions between parallel rows of the fuel pins in the fuel element assembly, a closely spaced pair of the strip

members extending parallel to one another between each row of the fuel pins and the next, the intersecting strip members defining a plurality of cells each penetrated by a fuel pin, and the fuel pins being laterally located in the fuel element assembly by contact with the walls of the cells. (Official Gazette)

20490 NUCLEAR REACTOR FUEL ASSEMBLY SPACER GRID. Leaver, B.; Seddon, T. (to United Kingdom Atomic Energy Authority). US Patent 3,824,153. 16 Jul 1974. Priority Date 7 Jul 1971, United Kingdom of Great Britain and Northern Ireland. 4p.

A spacer grid in a fuel element assembly including a plurality of elongate fuel pins supported in a bundle with their longitudiani axes parallel comprises a rigid grid structure of intersecting cross members defining cells each of which is penetrated by a fuel pin of the assembly and resilient strip members slotted through the grid structure parallel to the cross members, the resilient strip members providing transverse support for the fuel pins in the cells of the grid structure and stop means being formed projecting from the cross members inside the cells and underlying the strip members in the cells. (Official Gazette)

20491 METHOD OF AND APPARATUS FOR THE PRODUCTION OF COATED-PARTICLE FUEL FOR NUCLEAR REACTORS. Gyarmati, E.; Nickel, H.; Wallroth, C. F. (to Kernforschungsanlange Julich Gesellschaft mit beschrankter Haftung). US Patent 3,822,140. 2 Jul 1974. Priority Date 19 Dec 1970, F. R. Germany. 6p.

A method and apparatus are described for coating nuclear fuel particles in a fluidized bed with carbon deposited from a pyrolytically decomposable gas. The static layers in the fluidized bed coating system are broken up by generating a vortex or twisting displacement of the fluidized bed about its axis in a divergent conical fluidized bed chamber. Carrier gas is introduced axially into the bottom of the chamber and downwardly and tangentially through openings in the wall of the fluidized bed chamber. The tangentially and helical movement imparted to the gases in the chamber results in an improved coating uniformity on the particles. (Official Gazette)

20492 METHOD OF ASSEMBLING NUCLEAR REACTOR FUEL ELEMENT SPACER ASSEMBLY. Iwao, K. R.; Yee, D. (to Continental Oil Co.). US Patent 3,820,225. 28 Jun 1974. Filed Date 12 Jul 1972. 6p.

A nuclear reactor fuel element spacer arrangement is described which has a fuel rods supporting and spacing means in the form of resilient slotted spacer tubes mounted on tie rods or bars secured to a supporting sleeve. The spaces between the spacer tubes are such that the fuel elements are gripped between adjacent spacer tubes or between spacer tubes and portions of the sleeve. The arrangement facilitates loading of the fuel elements and minimizes scratching of the fuel elements. (Official Gazette)

20493 METHOD OF ASSEMBLING NUCLEAR REACTOR FUEL ELEMENT SPACER ASSEMBLY. Nakazato, S. (to Continental Oil Co.). US Patent 3,820,226. 28 Jun 1974. Filed Date 12 Jul 1972. 6p.

A nuclear reactor fuel element spacer arrangement is described which has a fuel element supporting and spacing means in the form of spacer tubes mounted on tie rods or bars secured to a resilient supporting sleeve with the tie rods in tension. The spaces between the spacer tubes are such that the fuel elements are gripped between adjacent spacer tubes or between spacer tubes and portions of the sleeve. The arrangement facilitates loading of the fuel elements and minimizes scratching of the fuel elements. (Official Gazette)

Reactor Control Systems

20494 (CONF-721237-, pp 221-235) CALCULATION FOR THE CHOICE AND JUSTIFICATION OF THE CONTROL SYSTEM OF BOR-60 REACTOR. Leipunskii, A. I.; Orlov, V. V.; Troyanov, M. F.; Matveev, V. I.; Chernyi, V. A.; Pshakin, G. M.; Ivanov, A. P.; Novoshilov, A. I.; Zhukov, A. V. (Physics and Power Inst., Obninsk, USSR). 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

The results of the investigations on the analysis of the reactivity effects which occur during the operation of the reactor are given. The temperature and power effects of the reactivity, the sodium void effect, and the reactivity variation during the fuel burnup are examined. The general characteristics of the control system are studied. The results of the calculations of the worth of the control system that have been effected using various methods are also examined. The results are given of the measurements of the worth of the experimental model of control systems on the critical assembly BFS-21, the mock up of the reactor BOR. On the basis of the experimental data, the worth of the control system of the reactor is improved. (4 references) (auth)

20495 (CONF-721237-, pp 457-470) EXPERIMENTAL AND COMPUTATIONAL STUDIES OF THE PHYSICS OF CONTROL RODS OF THE BN-350 REACTOR IN BFS-22 ASSEMBLY. Orlov, V. V.; Troyanov, M. F.; Mamontov, V. F.; Matveev, V. I.; Gorbatov, N. E.; Pshakin, G. M.; Bondarenko, V. V. (Physics and Power Inst., Obninsk, USSR). 1972.

From Indo-Soviet seminar on fast reactors; Kalpakkam, India (6 Dec 1972).

The results of the experimental studies of the physics of control rods that have been carried out in BFS-22 assembly which is one of the mock-ups of BN-350 reactor are given. The results of suspending the samples of various materials and models of control rods including the absorbing rods containing moderator are given. The comparative analysis of the experimental and calculated values that have been obtained by using different calculation methods and systems of multi-group constant is given. The experimental and computational studies of sodium void effect of reactivity near the absorbing rod are also given. (6 references) (auth)

20496 (IKE-6-65) STATE FEEDBACK OF AN INCORE-THERMIONIC REACTOR USING MULTIVARIABLE DECOUPLING TECHNIQUE. Ferg, D. A.; Dagbjartsson, S. (Stuttgart Univ. (TH) (F. R. Germany). Inst. fuer Kernenergetik). Mar 1973. 85p. INIS.

With figs.; 10 refs.; 2 apps.

An initial control system design employing multivariable state feedback techniques on an experimental ITR ground version power system is described. It has been attempted to formulate a basic design procedure and to provide the basis for more detailed studies involving incore thermionic reactor systems. The control system presented in this study possesses two modes of operation. The first is called the braking mode in which the plant is maintained at preset reactor operating conditions. The second level of operation is called the driving mode and with an operators command, overrides the normal braking mode of operation. The control system for both modes of operation is designed using decoupling techniques associated with linear multivariable systems. (GE)

20497 (UTIA-416) ALGORITHMS FOR COMPUTER SAFETY SYSTEM OF NUCLEAR REACTOR. Kovanic, P.; Thoma, M. (Ceskoslovenska Akademie Ved, Prague. Ustav Teorie Informance a Automatizace). Nov 1972. 74p. (In Czech).

Computer algorithms were evaluated for a nuclear reactor safety and control system, a suitable class of estimation procdures was selected, the dependence was evaluated of the estimation errors on a priori information, a number of practical formulas for optimum estimations is listed and their accuracy given, and the applicability was evaluated of simple estimators in decision-making algorithms of the safety and control system. For a practical application, the estimation process can preferably be implemented in four stages of various complexity. The system can be applied with constant estimators with finite memory which use the information on mean values and covariances and decision-making algorithms, simplified to a maximum, both for the ascertainment of emergencies and for their identification. The simplification can best be achieved by the suppression of random distrubance effects as a result of the application of optimum estimators prior to decision-making. (Nuclear Sci. Abstr. Czech)

20498 TECHNICAL SYSTEMS ANALYSIS AND RELIABILITY TECHNIQUE. Report on the Second Information Day Organized by the LRA Garching. Muench, E. (Kernforschungsanlage Juelich G.m.b.H.). Technische Systemanalyse und Zuverlaessigkeitstechnik; 19: No. 4, 207 (Apr 1974). (In German).

From second information meeting of the Laboratorium fuer Reaktorregelung und Anlagensicherung, Garching. Main topic: systems analysis and reliability engineering; Garching/Munich, Ger. (16 Jan 1974).

A report is presented on the second information meeting of the LRA Garching, which is doing research in the following fields: 1) Simulations of perturbations, 2) system analysis and reliability techniques, 3) analysis of stochastic processes, 4) use of process computers in reactors, 5) criticality values in the fuel cycle. (GE)

20499 ANALYSIS OF POWER DISTRIBUTION CONTROL SYSTEM STABILITY IN A REACTOR CORE. Filipchuk, E. V.; Potapenko, P. T.; Kosilov, A. N. At. Energ. (USSR); 35: No. 5, 317-321 (Nov 1973). (In Russian).

The problem of automatic control of radial power distribution in a nuclear reactor is considered. For monitoring and control purposes, the reactor core is divided into m equal cells, each having a neutron flux detector at its center. The cells contain equal

numbers of shim rods, which move synchronously during operation. An engineering method of analysis of power distribution control system stability in a reactor core is presented. This technique is used where the integrated reactor power is stabilized by a special fast regulator. The effect on stability of a number of local regulators and their geometrical arrangement in the core is analyzed. (auth)

Nuclear Power Plant Economics

20500 EFFICIENCY OF ATOMIC HEAT SUPPLY PLANTS. Arsen'ev, Yu. D.; Voronkov, M. E.; Sinev, N. M. Sov. At. Energy (Engl. Transl.); 35: No. 3, 838-839(Sep 1973).

Translated from At. Energ. (USSR); 35: No. 3, 197-198(Sep 1973).

The economics of using nuclear reactors as thermal energy sources for heating applications are considered. It is shown that more efficient use of both fossil and nuclear fuel supplies could be achieved by increasing the use of reactors in heat supply plants, and using the fossil fuels saved to generate electricity. (DG)

20501 EFFECT OF RELIABILITY ON THE OPERATING EFFICIENCY OF LARGE STEAM-ELECTRIC POWER STATIONS. Bortlik, J. (Vyzkumny Ustav Energeticky, Prague). Energetika; 24: No. 5, 193-195(May 1974). (In Czech).

Reliability evaluations based on statistics and operational data from power plants equipped with 200 MW and 400 MW conventional power units and the VVER 440 type nuclear power unit, which is the basis of future development in the Czechoslovak electric system, were used to determine the operating efficiency of steam-electric power plants. The necessary principles for evaluating reliability from engineering and economic points of view are presented together with an analysis of the results. (auth)

20502 WORLD'S FIRST ATOMIC POWER STATION AND NUCLEAR POWER GROWTH. Petros'yants, A. M. At. Energ. (USSR); 36: No. 6, 419-422(Jun 1974). (In Russian).

The significance of the APS reactor in Obninsk in the development of the world's nuclear power is discussed. Data on the number and capacity of atomic power stations in operation and forecasts for the years 1980 and 2000 are presented. Economic and political causes for the 1973-74 energy crisis are described. The place and role of fast reactors in nuclear power structure receives consideration. An enumeration of fast and thermal reactors in operation in the Soviet Union also is included. The role of international cooperation in the expansion of peaceful uses of atomic energy is shown. (auth)

20503 CHANGED ESTIMATES OF THE ECONOMY OF VARIOUS TYPES OF REACTORS FOR ATOMIC POWER STATIONS BETWEEN THE THIRD AND FOURTH GENEVA CONFERENCES. Feinberg, S. M.; Poznyakov, N. L. At. Energ. (USSR); 36: No. 6, 469-478(Jun 1974). (In Russian).

An analysis of foreign publications of economic indicators for atomic power stations based on various types of reactors is presented. The analysis indicates that during recent years significant changes in the economy of atomic power stations have occurred. It is concluded that thermal reactors will maintain their advantage and competitiveness for a long time, while the economic indicators of fast breeder reactors have not yet been sufficiently clearly determined. Heavy water reactors are included among reactors with a future. (auth)

20504 MATHEMATICAL MODELING OF NUCLEAR POWER GROWTH. Koryakin, Yu. I.; Baturov, B. B.; Belostotskii, A. M.; Bobolovich, V. N.; Levental, G. B.; Lokshin, V. L.; Smirnov, V. G.; Chernavskii, S. Ya.; Barabanov, V. I.; Shkrabal, I. At. Energ. (USSR); 36: No. 6, 458-468(Jun 1974). (In Russian).

A mutually interconnected system of models which permits computers to analyze the prospective growth of nuclear power in the USSR as well as within the CMEA countries is described. The first group of models is designed to estimate the future structure of nuclear power, the second to estimate the role of nuclear power in the fuel-energy balance taking into account its relations to other complexes of the economy, and the third to determine the parameters of atomic power stations taking into account their regimes of operation in the electric power system. It is shown that, in view of the complexity of the nuclear power system and the numerous factors affecting its future growth, mathematical modelling is a necessary instrument for solving important tasks of national planning, forecasting and engineering policy in the field of nuclear power and the fuel-energy complex as a whole. (auth)

20505 BILIBIN NUCLEAR POWER PLANT AND THE ENERGY SITUATION IN THE USSR. Com. Naz. Energ. Nucl., Notiz.; 20: No. 4, 94-101(Apr 1974). (In Italian).

The energy situation in the USSR is briefly described, and the utilization of small power plants in remote regions is discussed. A description of the Bilibin nuclear power plant is given. (auth)

20506 NUCLEAR POWER STATIONS IN EUROPE. Experience Acquired in Industrial Exploitation. Speri, G. (Ente Nazionale per l'Energia Elettrica, Rome). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 104, 16-29(Nov 1973). (In French).

From fifth FORATOM congress on nuclear power plants in Europe; Florence, Italy (15 Oct 1973).

The principal characteristics of nuclear plants in use in various FORATOM member countries are reviewed together with the behavior of the different types of installation (availability and reliability of water and gas-graphite reactors). Problems associated with fuel, nuclear safety, and environmental protection are examined. (FR)

20507 NUCLEAR POWER STATIONS IN EUROPE. Experience Acquired in the Development and Construction of Industrial Power Plants. Tupini, G. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 104, 6-15(Nov 1973). (In French).

From fifth FORATOM congress on nuclear power plants in Europe; Florence, Italy (15 Oct 1973).

The philosophy behind the decision taken to construct nuclear plants instead of traditional ones is presented together with the various different contracts associated with the installation of such plants. The consequences of modifications made during construction, safety problems encountered in the different projects, and constructional delays are considered. Developments in industrial structures resulting from advancements in nuclear science are discussed together with the relations maintained with research organizations and the diffusion of technical know-how. (FR)

20508 NUCLEAR POWER STATIONS IN EUROPE. Future Industrial Outlook. Sette, P. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 105, 20-24(Jan 1974). (In French).

From fifth FORATOM congress on nuclear power plants in Europe; Florence, Italy (15 Oct 1973).

The outlook for the nuclear power industry seems to be good. It is forecast that the exploitation of light water reactors will continue to be of great interest during coming years. The fuel cycle must be considered very seriously when examining the equipment, materials, and services necessary to carry out the nuclear programs envisaged. The quantities of material and business turnover figures (millions of dollars per year) were evaluated for the different phases of the cycle for the year 1980. (FR)

20509 NUCLEAR POWER STATIONS IN EUROPE. Combined Role of Proved, Advanced, and Fast Reactors. Angelini, A. M. (Ente Nazionale per l'Energia Elettrica, Rome). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 105, 25-34 (Jan 1974). (In French).

From fifth FORATOM congress on nuclear power plants in Europe; Florence, Italy (15 Oct 1973).

The developments forecast for the installation of nuclear plants throughout Western Europe are reviewed. The roles envisaged for the different reactor types are analyzed: proven reactors, i.e., these for which experience in industrial installations has already been acquired (light water reactors, natural uranium-graphite-gas reactors); advanced convertor-type reactors, i.e., nonbreeder thermal type reactors enabling a better use to be made of the natural U content than is possible with the earlier reactor types (natural uranium-heavy water reactors, high temperature gas reactors); and breeder reactors. (FR)

20510 NUCLEAR POWER STATIONS IN EUROPE. Development in the Fields of Development and Construction. Franco, G. (Comitato Nazionale per l'Energie Nucleare, Rome). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 104, 30-37(Nov 1973). (In French).

From fifth FORATOM congress on nuclear power plants in Europe; Florence, Italy (15 Oct 1973).

Progress made by FORATOM member countries in the development and construction of nuclear power plants is presented. Some particular problems are examined: site selection; authorization procedures; organization; project; code and standards criteria; components industry; and costs. (FR)

20511 NUCLEAR POWER GENERATION. Schmidt, G. Brennst.-Waerme-Kraft; 26: No. 4, 141-144(Apr 1974). (In German).

A review is given of the present state-of-art of nuclear power

reactor development and the activities of the nuclear industry in this field as well as with regard to the nuclear fuel cycle. (GE)

20512 SOME DATA ON JAPAN'S NUCLEAR POWER INDUSTRY. Antipin, A. N. Arch. Energiewirtsch.; 28: No. 4, 155-158(Feb 1974). (In German).

1 tab.; 3 refs.

A review is presented of Japan's 10-year program for the construction of nuclear power plants, providing for the commissioning of 21 power plant units with a total capacity of 15,710 MW, the construction of another 25 power plant units and an overall installed capacity of 27 GW up to the year 1980. The paper also discusses details of Japan's efforts and activities in the field of nuclear research (atomic energy commission similar to that of the US, three research centers, special association of utilities), mining and import of uranium ores, the shift from thermal reactors to fast breeders planned to be realized by the mid 1980's, and economical and political aspects of reactor and fast breeder technology. (GE)

Reactor Fuel Cycle Economics

Refer also to abstracts 20330–20332, 20342, 20358, 20456, 20457, and 20511.

20513 (ANS-RPD-4) SPECIAL SESSION OF INVITED PAPERS ON PHYSICS OF PLUTONIUM RECYCLE. Proceedings Presented at the 1971 Winter Meeting of the American Nuclear Society, Miami, Florida, October 17–21, 1971. (American Nuclear Society, Hinsdale, Ill.). [nd]. 172p. (CONF-711085-). Dep. NTIS $11.75.

Seven papers on plutonium recycle are included. A separate abstract was prepared for each paper. (DG)

For abstracts of individual papers see: 20330–20332, 20342, 20358, 20456, and 20457.

20514 VALUE OF PLUTONIUM IN DEVELOPING A NUCLEAR POWER SYSTEM. Bryunin, S. V.; Koryakin, Yu. I.; Lokshin, V. L.; Runin, V. I.; Chernavskii, S. Ya. At. Energ. (USSR); 35: No. 5, 305-309(Nov 1973). (In Russian).

An approach to the determination of the value of plutonium in a nuclear power system as a function of its parameters, strategy of development, and cost of electric energy is considered. The value of plutonium in nuclear power systems having various structures and commissioning time is analyzed, and economic indicators of fast breeder reactors are given. The effect of uranium consumption restrictions on the value of plutonium in a nuclear power system is considered. A number of quantitative conclusions regarding expedient regimes of production and consumption of plutonium are drawn. (auth)

Reactor Licensing and Regulation

Refer also to abstract 20422.

20515 (DOCKET-STN-50488-11) THOMAS L. PERKINS NUCLEAR STATION, UNITS 1, 2, AND 3. License Application, Environmental Report, Volume 1. (Duke Power Co., Charlotte, N. C. (USA)). 1974. 589p. (DOCKET-STN-50489-11; DOCKET-STN-50490-11). Dep. NTIS $32.50.

20516 (PRDI-74-7) TITLE LISTING OF POWER REACTOR DOCKET INFORMATION. (USAEC Technical Information Center, Oak Ridge, Tenn.). Jul 1974. 85p. TIC $1.45.

Citations and subject indexing to the documentation associated with civilian nuclear power plants are presented. This material is that which is submitted to the Atomic Energy Commission in support of applications for construction and operating licenses. Citations are listed by Docket number in accession number sequence. The Table of Contents is arranged both by Docket number and by nuclear power plant name. (JWR)

20517 APPROVING NUCLEAR POWER PLANTS: SCIENTIFIC DECISION MAKING OR ADMINISTRATIVE CHARADE. Joskow, P. L. (Massachusetts Inst. of Tech., Cambridge). Bell J. Econ. Manage. Sci.; 5: No. 1, 320-332(Spr 1974).

Nuclear reactor licensing procedures are examined with regard to their relationship to environmental and safety considerations. Special attention is given to the manner in which cost-benefit studies are carried out. (DG)

20518 REGULATION OF REACTOR INSTALLATIONS AND DISPOSAL OF RADIOACTIVE WASTES. Kodama, K. (Science and Tech. Agency, Tokyo). pp 318-372 of Siting and Environmental Problems in the Development of Electric Power Stations: Its Status and Analysis. Tomioka, K. (ed.). Tokyo; Fuji International Co. (1973). (In Japanese)

In Japan, the development and utilization of atomic energy is limited to peaceful purposes on a basis of absolute safety, and governmental inspection is carried out in accordance with legal requirements before installation of reactor plants. Concerning the regulation of reactor installations, the following are described: safety of nuclear reactors, statutory regulation of nuclear reactors, and regulation in overseas countries. To protect the people, radiation control and the disposal of radioactive wastes are carried out rigorously. Disposal techniques for gaseous, liquid and solid wastes from BWR, PWR and GR power plants are reviewed. (JA)

20519 FRENCH NUCLEAR INSTALLATION REGIME AFTER THE 1973 REFORMS. Hebert, J. (Electricite de France, Paris). Bull. Droit Nucl.; No. 12, 39-46(Nov 1973). (In French).

The origins and development of nuclear installation legislation up to 1973 are recalled. The effects of the reforms introduced by the decree of March 27, 1973, (which modified the basic nuclear installation policy), and by the decisions of the 13th and 27th of March on safety matters are examined together with the decisions in texts about to be published on the disposal of radioactive effluents and the protection of workers in basic nuclear installations. (FR)

20520 NUCLEAR POWER PLANT ENVIRONMENTAL REPORTS. Robinson, M. J.; Smith, E. O. (Black and Veatch Consulting Engineers, Kansas City, MO). IEEE (Inst. Elec. Electron. Eng.), Trans. Power App. Syst.; PAS-93: No. 1, 321-324(1974).

From IEEE PES summer meeting and EHV/UHV conference; Vancouver, B. C. (15 Jul 1973).

The environmental report requirements for nuclear power plant construction and operating permits are discussed. The current guidance furnished by the Atomic Energy Commission is discussed and the implications regarding timing and possible criticisms by the public are pointed out. Examples from current licensing and permit hearings are discussed in the context of how to minimize the conflicts that might arise. (auth)

20521 APPLICATION FOR A LEGAL AID CERTIFICATE FOR A NUCLEAR POWER PLANT LAW CASE REFUSED. Energiewirtsch. Tagesfragen; 24: No. 5, 259-260(May 1974). (In German).

The Administrative Court of Baden-Wuerttemberg has refused with order of April 8, 1974-IX 6/74 a complaint against the refusal of a legal aid certificate for a nuclear power plant law case (Neckarwestheim reactor). The complaint is admissible but without reasonable cause, because there is reasonable suspicion that the plaintiff as poor party is pleaded for the purpose to enable the "Protective Union against Nuclear Power Plants and Environmental Damage" at Lauffen a conduct of the case with legal cost risk on charge of the public. (GE)

GENERAL

Energy Utilization and Economics

Refer also to abstract 18686.

20522 (ORNL-EIS-74-52(Vol. 2) (No. 2)) NSF-RANN ENERGY ABSTRACTS. A Monthly Abstract Journal of Energy Research. Guthrie, M. P. (ed.). (Oak Ridge National Lab., Tenn. (USA)). Feb 1974. Contract W-7405-eng-26. 41p. Dep. NTIS $5.25.

Eighty-six abstracts relating to the following areas of energy are included: conservation, policy, demand consumption, sources, and electric power (system planning, demand, generation, and transmission and distribution. (MCW)

20523 (UCRL-51578) REVISED COST ESTIMATE FOR THE LLL IN SITU COAL GASIFICATION CONCEPT. Stephens, D. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 20 May 1974. Contract W-7405-eng-48. 35p. Dep. NTIS $4.00.

Cost estimates for the LLL in situ coal gasification concept using chemical explosive fracturing are revised on the basis of processing costs reported by the El Paso Natural Gas Company and WESCO for their proposed Lurgi coal gasification plants in New Mexico. Gas selling prices are calculated using the utility financing method recommended by the Federal Power Commission (FPC) Task Force. Conservative and optimistic cases are postulated. For the conservative case, surface plant capital investment and annual operating costs are estimated to be $221 million and $16.7 million, respectively, in 1974 dollars. The gas selling price varies with assumed coal bed thickness and depth, being less than $1 per million Btu for the conservative case under the following circumstances: 50-ft-thick coal bed at less than 1500-ft depth; 100-ft-thick coal bed at less than 2100-ft depth; and 200-ft-thick coal bed at 3000-ft depth. For the optimistic case, assuming that no sulfur gases are produced and that methane and carbon dioxide are the primary underground products, the price is 21¢ per million Btu less than for the conservative case. For an existing coal deposit near Gillette, Wyoming, where a 600-ft coal-shale sequence is located at an average depth of 1185 ft and contains 244 ft of coal in three beds, the optimistic and conservative cost estimates are bounded by 47 to 68¢ per million Btu. These prices can be compared to surface processing estimates using the same procedures: $1.37 per million Btu for the existing Lurgi process and $1.17 per million Btu for new high-Btu, surface coal gasification processes under sponsorship of the U. S. government and the American Gas Association. There is a considerable potential cost advantage to in situ coal gasification using chemical explosive fracturing. (auth)

Information Handling

20524 (CONF-740309-1) SPEAKEASY: AN EVOLUTIONARY SYSTEM. Cohen, S. (Argonne National Lab., Ill. (USA)). 1974. 10p. Dep. NTIS $3.00.

From symposium on very high level languages; Santa Monica, California, USA (28 Mar 1974).

20525 (GSF-A-34) SCIENTIFIC PUBLICATIONS AND REPORTS 1970. (Gesellschaft fuer Strahlen- und Umweltforschung m. b. H., Neuherberg/Muenchen (F. R. Germany)). Jul 1971. 23p. (In German). INIS.

This list of publications is a continuation of the GSF-report A 29 which covered the scientific literature published by members of the GSF in 1969, as well as internal reports of this year. The compilation lists all scientific publications of the GSF of the year 1970. Contributions to scientific journals and books are provided with the code letter of the institute of origin and a number. (GE)

20526 (GSF-A-42) SCIENTIFICE PUBLICATIONS AND REPORTS 1972. (Gesellschaft fuer Strahlen- und Umweltforschung m. b. H., Neuherberg/Muenchen (F. R. Germany)). Jun 1973. 32p. (In German). INIS.

20527 (IS-3389) DATA BASE DESIGN CONSIDERATIONS FOR A KEY WORD BASED RETROSPECTIVE INFORMATION RETRIEVAL SYSTEM. Jordan, J. R.; Maple, C. G. (Ames Lab., Iowa (USA)). Jun 1974. Contract W-7405-eng-82. 12p. Dep. NTIS $4.00.

The nature of a key-word based information retrieval system is examined and the various problems involved are discussed. The reason for choosing the Indexed Sequential Access Method (ISAM) for file structure is analyzed. (auth)

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Law

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Refer also to abstract 18907.

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